Railway and Locomotive Engineering

INDEX FOR VOLUME XXI, 1908

(Illustrated Articles Marked *)

M

N

O

P

Q

R

S

T

U

V

W

Railway and Locomotive Engineering

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A Practical Journal of Motive Power, Rolling Stock and Appliances

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The Overland.

It was on the Union Pacific Railroad that Phileas Fogg was a passenger in his celebrated trip Around the World in Eighty Days, of which Jules Verne writes in his interesting romance of travel and adventure. Mr. Fogg made the supposed trip about a quarter of a century ago, and in writing of the "Pacific" railroad of those days the author speaks of the American train which his ultra-English hero found ready to start from San Francisco. Jules Verne says of it: "Through the whole length of the train the cars communicated by platforms, and the passengers could move about from one end to the other of the train, which placed at their disposal palace, balcony, restaurant and smoking cars. All that is wanting is a theatre car, but that will come some day." The equipment of the Union Pacific trains to-day consists of palace cars, diners and observation cars, which latter is probably what Jules Verne meant by "balcony" cars. The modern cars are all much longer, heavier, safer and far more comfortable than those in which the sedate and very English Mr. Fogg traveled.

THE "OVERLAND LIMITED" ON THE UNION PACIFIC RAILROAD.

The Overland Limited is the name of a very well known train, or rather system of trains on that road, for there is more than one which bears that designation, but the name is no doubt derived from the older expression "Overland Route" which was given by the inhabitants of Great Britain to their alternative route to India. One might go from London to India by water or one might cross to the continent and go by rail to Brindisi. If you consult your atlas you will find that Brindisi is almost at the heel of Italy, relatively just about where the heel and sole of the shoe join. From Brindisi the rest of the journey is made by water usually in one of the P. & O. steamers. Although there is a good deal of water travel on any trip to India, yet by reason of the railway journey from the north of France to the south of Italy the name "Overland Route" was given to that mode of travel.

On the Union Pacific, No. 1 is the Westbound Overland Limited running from Council Bluffs to San Francisco and No. 2 is the eastbound train between these cities. The equipment of these trains is of the most modern type. The train is for first-class sleeping car passengers only, and has a handsome new equipment of Pullman standard draw-

ing-room and private compartment sleeping cars. A composite-observation car, with observation parlor and buffet-smoking apartment, is one of the features of the equipment. The observation parlor is especially designed for the comfort of the ladies. This apartment is furnished with luxurious easy chairs, an excellent library and writing desks. The broad and roomy observation platform is frequented during the day. The dining car service is another notable feature of the train. The entire train is lighted by electricity, including both ceiling and side lights. Berth reading lamps of the most modern design are conveniently placed in each section and drawing room.

Our frontispiece illustration this month shows the Overland Limited bowling along amid the varied scenery and natural wonders with which the route abounds. Train No. 1 leaves Omaha at 8:50 A. M. daily and arrives at San Francisco at 8:28 A. M. on the third day thereafter. It traverses the 1,789 miles between those points in 47 hours and 38 minutes according to the time table. At North Platte, Neb., however, the west-bound traveler puts back his watch one hour as he passes from Central to Mountain time. Another hour is dropped from the reckoning at Sparks, Nev., as the train passes from Mountain to Pacific standard time. This makes the actual running time 45 hours and 38 minutes, or 2,738 minutes, and the average speed is therefore about 39 miles an hour.

The westward trip on the Union Pacific is practically a gradual rise beginning at Council Bluffs, which is 980 ft. above sea level, on to Cheyenne, which is 6,050 ft. high. This gradual ascent going west is a marked feature of all the transcontinental lines in America, and a curious circumstance grew out of it when the Union Pacific was in course of construction.

Many years ago the gradual ascent of the eastern slope of the Rocky Mountains from the prairie became the subject of discussion between the U. S. Government engineers and those of the Union Pacific Railroad. By agreement, this road was to receive $16,000 a mile for the construction of the prairie section, and treble that amount for the mountain section. At length the construction engineers found themselves at Sherman, 8,000 ft. above the sea, then the highest railway summit in the world, without having drawn any extra subsidy for mountain work. A representation of the facts was made to the government engineers, and the question was raised as to where the mountain section actually commenced. A point in the vicinity of Cheyenne was finally agreed upon as the place where the heavier grades began. There was not much difference in the character of the work while ascending the eastern slope, but it was decided that this point was the one where the prairie section ended and mountain construction legitimately began. After passing Sherman there are yet many steep ascents and sharp down grades, but the gradual slope of the road falls toward the Pacific.

FISH CUT, UNION PACIFIC.

COMING TO GRANITE CANYON

One of the most interesting features of this fascinating line is the magnificent piece of engineering work known as the Lucin Cut-Off. This work carries the railroad over the Great Salt Lake partly on an embankment and partly on a trestle, and shortens the distance between Ogden and Lucin by about 42 miles, besides eliminating many curves and grades. The great salt lake desert lies to the west of Salt Lake. This desert, together with the lake, was once covered with water to a depth of a thousand feet.

This pre-historic lake with its ancient shore line still visible away up on the sides of the surrounding mountains was quite as large as Lake Michigan and much deeper. No man ever saw this lake, but the name Lake Bonneville has been given the huge sheet of water that once was there. The name is used to commemorate the explorations between 1831-3 of the intrepid Captain B. L. E. Bonneville, of the U. S. Army, who first saw the Great Salt Lake as it is known to us. In writing of Bonneville in 1861 Washington Irving gives an account of what the early explorer saw, and speaking of Salt Lake he says, "In the spring

when the streams are swollen by rain and by the melting of the snows, the lake rises several feet above its ordinary level; during the summer it gradually

CROSSING GREAT SALT LAKE.

subsides again, leaving a sparkling zone of the finest salt upon its shores."

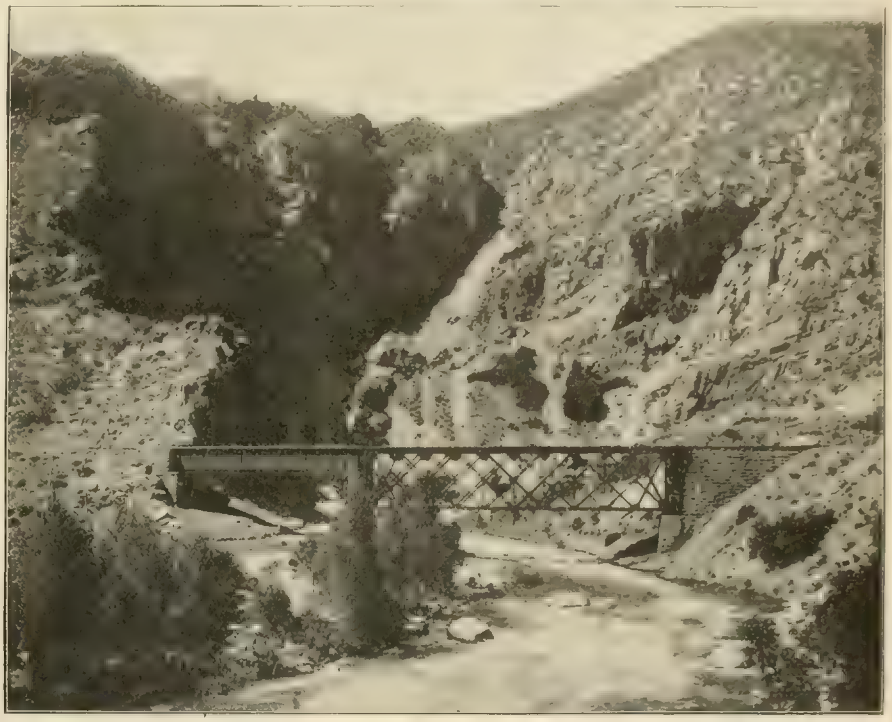
The first mention of the Great Salt Lake was by Baron La Hontan, in 1689, who did not himself visit it, but who gathered some notions of it from the Indians west of the Mississippi. Then came Bonneville about 1831, who described the lake, without having made any systematic survey of the region. It was explored and described in 1843 by Colonel Fremont. A thorough survey was made in 1849-1850 by Captain Howard Stansbury of the United States army, whose report was printed in 1852.

Great Salt Lake lies in an enormous basin between the mountains, and is about 83 miles long and about 51 miles wide. Its average depth is only about seven feet. It is said to be the most salty lake in the world, with the exception of the Dead Sea. Fish cannot live in its waters. It contains about 22 per cent. of sodium chloride or common salt. This lake receives from the south, by a river called the Jordan, the waters of the Utah Lake, and those of the Wear River from the north. Salt Lake has no outlet, and has been called the "still innocent Dead Sea." The water which pours into it, though fresh, contains, as all river waters do, a minute quantity of salt, and as the level of the lake is kept down entirely by evaporation, it follows that the waters have in the lapse of ages become quite salt, and will continue to get saltier as time goes on. Reclus says that in fine weather one might almost go to sleep on the tranquil waters of the lake without fear of being drowned, as it is impossible to sink.

Stansbury believes that even an expert swimmer would perish if compelled to swim for any considerable distance against the force of the winds and waves, on account of the intense suffering caused if even a drop of the water gets into the eyes or on account of the paroxysms of coughing caused if even a small quantity be swallowed

The Lucin Cut-Off is the name on the Union Pacific given to a piece of main line from Ogden to Lucin, straight across Great Salt Lake and across the desert which formed the bed of Lake Bonneville in geologic times. This line is 103 miles long. Twenty-seven and a half miles is over the lake, and of this distance sixteen miles is on an earth embankment and the rest is on trestle. The number of curves eliminated by the new line would turn a train eleven times around. The difference in the grades on the cut off and those of the old line are very marked. The old line had several long grades 1.26, 1.37, and up Promontory Mountain 1.70 per cent. as against a maximum of only 0.4 per cent. for very short distances on the Cut-Off.

The march of progress is seen everywhere on this line. In the fifties it took "the Overland Mail" stage coach 23 days 21 hours to travel from St. Louis to San Francisco. In the sixties "The Pony Express" was nine days making the trip from St. Joseph, Mo., to San Francisco. To-day the Overland Limited goes from Council Bluffs to the Pacific in less than three days over a block signaled road through the wonders of Echo canyon, over the famous Salt Lake, the desert, past the high Sierras, through the Palisades into California and on to the tide waters of the great Pacific.



DEVIL'S GATE, WEBER'S CANYON, UNION PACIFIC.

Concrete and Glass Telegraph Poles.

Many experiments have been made in America with the combinations of concrete and iron for telegraph poles, but the poles so made have not been altogether satisfactory. The growing expense of good timber for telegraph poles will keep stimulating the companies until they find good substitutes. We notice that the inventors in other countries are trying to find a substitute for wooden poles and their efforts will be watched with interest.

A patent has been granted in Germany for an invention for the manufacture of glass telegraph and telephone poles. A company has been organized, and a factory for the manufacturing of glass poles has been built at Gross-Almerode, near Frankfurt. The glass mass of which the poles are made is strengthened by wire threads. One of the principal advantages of these poles would be their use in tropical countries, where the wooden poles are soon destroyed by the ravages of insects and climatic influences.

WESTWARD THROUGH THE PALISADES

Coming of Age of "L. E."

With this year RAILWAY AND LOCOMOTIVE ENGINEERING becomes of age, reaching its twenty-first birthday. On this occasion we believe it right and proper that we publish a brief history of the birth and breeding of the journal, for the information of the host of readers in every State and clime, and particularly for the hosts of friends who regard it with affectionate tenderness as their "favorite paper," and are so ready to comfort us with that assurance.

In January, 1887, the American Machinist Publishing Co., 96 Fulton street, New York, published the first number of the LOCOMOTIVE ENGINEER. Horace B. Miller was president and business manager; Lycurgus B. Moone, treasurer and secretary, and John A. Hill, editor, who introduced himself in this fashion:

"The editor selected for the LOCOMOTIVE ENGINEER is not a graduate of any school of technology; he is not a mechanical engineer, a master mechanic or a machinist; he did not run the first locomotive in America and every kind made since the first engine was probably worn

JOHN A. HILL.

out before he was born. He was a fireman for some years, and has been an engineer for several more. He did not run before the War or before the day of lubricators and injectors, but left the throttle of a locomotive to accept his present position. He hopes and expects, as one of themselves, that the engineers, firemen and repair shopmen of America will enter into the discussion of practical subjects in this paper with all the free-

ANGUS SINCLAIR.

dom they would enter into an argument in the roundhouse."

A somewhat vague statement regarding the purpose of the paper was given "From the Publishers' Standpoint," but one reads it to-day and wonders what they intended to tell their subscribers. However that may have been, Mr. Hill proceeded to give the readers what was probably the most attractive and practical railroad paper ever published. The size of page was 12 x 9 inches, and 12 pages of reading matter were given each month, the price being one dollar a year.

The subjects discussed embraced everything relating to the motive power and operation of railroads, in short, succinct articles seldom exceeding one thousand words. Correspondents readily volunteered to ventilate their opinions, and discussions of practical subjects soon became a valuable feature of the paper.

From the first issue the LOCOMOTIVE ENGINEER gave an excellent record of each month's doings in the railroad world and provided reading that was always so alluring that men looked for it regularly who had never previously cared to read anything better than sensational prints. Mr. Hill, under the pen names of John Alexander and Skinny Skeevers, provided articles and stories that were of extraordinary interest, and the paper grew in circulation as no railroad paper had ever grown before, and it soon had three times the circulation of any other railroad paper.

In ordinary publications advertising patronage keeps up with the circulation, but the LOCOMOTIVE ENGINEER was an exception in this respect. As long as it remained in the hands of the original publishers the paper did not receive more than one-tenth of the advertising patronage extended to other railroad papers. Although the paper reached as many officials who influenced the purchase of railroad supplies as any in the field, its rivals seemed to unite in repeating the lie that it reached only engineers and firemen, consequently advertisers regarded it as a poor medium.

By the time the paper had been three years old the publishers were becoming discouraged. As time went on prospects did not improve, and rumors of a desire to sell became current. Mr. Hill was convinced that with the right partner the paper could be put upon a paying basis. He decided that his friend, Angus Sinclair, was the right man for a partner. It took several months to convince Angus that the enterprise would be safe, but that was done

ONE OF THE EARLY COPIES.

eventually, and in October, 1891, the partnership of Sinclair & Hill was formed and the LOCOMOTIVE ENGINEER was purchased.

The partners rented a very modest office in Temple Court Building, New

York, and started out to force success by hard work. The working force besides the partners consisted of a bookkeeper, a stenographer and a boy. An advertising agent was located in Chicago. The name of the paper was changed to LOCOMOTIVE ENGINEERING, which indicated wider scope, and it was doubled in size and the price raised to two dollars a year.

The first issue prepared by the combined partners appeared in January, 1892. It contained articles from seven railroad officials, among them W. S. Mellen, general manager of the Northern Pacific; John Player, superintendent of motive power of the Atchison, Topeka & Santa Fe; A. M. Woitt, general master car builder of the Lake Shore & Michigan Southern; and J. B. Barnes, superintendent of motive power of the Wabash. The improved and expanded form of the paper made a wonderfully good impression and the publishers were flooded with letters of congratulation from all classes of railroad men. The success of the enterprise was assured, and nothing more was necessary than to keep the paper up to the initial standard. Both partners worked upon the policy that every succeeding number could be made a little better than those that had appeared before.

JAMES KENNEDY.

About the time the LOCOMOTIVE ENGINEER was established, railroad managers were beginning to demand that the train men should prepare themselves with sufficient practical and technical education regarding their business to pass an examination before being promoted. Mr. Hill tried to help the men over this difficulty by giving the paper an educational tone. As time went on the demand for instructive matter has steadily increased and the paper kept pace with this demand until now its educational features form an important part of each number. As the book "Locomotive Engine Running," by Angus Sinclair, published in 1884, was largely educational, the author has always been on congenial work preparing for LOCOMOTIVE ENGINEERING instructive papers calculated to educate trainmen. The educational part has not been permitted to interfere with the matter that constitutes a good, readable paper, but may be considered supplementary.

In the issue of June, 1897, appears the following notice: "With this issue Mr. John A. Hill, who was the first editor of the paper, severs his connection with LOCOMOTIVE ENGINEERING to become president and treasurer of the *American Machinist*. This change leaves Mr. Angus Sinclair sole proprietor of the paper, and for business convenience it has been incorporated into a joint stock company called the Angus Sinclair Company."

That change did not make material difference on the reading pages of the paper, for Mr. Hill had been occupied almost exclusively for several years with the business management, while Angus Sinclair was editor, the partners each doing the work for which he was best fitted.

During the twenty-one years of the paper's history there have been very few changes in the personnel. The first addition made was that of Fred. S. Hill, who attended to the subscription department for a time. Then A. Leighton Donnell took charge of the illustration department. In a very few years the editors found that the changes in air brakes were more than they could follow. As instruction relating to air brakes was an important feature of the paper, F. M. Nellis was engaged to manage that department,

GEORGE S. HODGINS.

and he remained with the company for many years. O. H. Reynolds was engaged as associate editor, and after a time was succeeded by Clinton B. Conger. Fred. H. Colvin entered the employ of the company as assistant business manager, and after a few years was succeeded by James R. Paterson. Joseph A. Baker was connected with the paper for a few years as associate editor and subscription manager.

The present staff consists of Angus Sinclair, president and chief editor; George S. Hodgins and James Kennedy, associate editors, and James R. Paterson,

JAMES R. PATERSON

secretary and treasurer. Our New England representative is S. I. Carpenter, while A. F. Sinclair is our Glasgow representative. A year ago we began publishing a European edition which is managed by The Locomotive Publishing Co., Paternoster Row, London.

RAILWAY AND LOCOMOTIVE ENGINEERING continues to have far the largest circulation of any railroad paper outside of the Brotherhood organs. It goes to all classes of railroad men from the humble wiper to the president. The paper goes to every country in the postal union and continues to spread into new fields. Its influence upon railroad men has been of the highest value and thousands are absorbing its instruction every month who never think of looking into any other technical publication.

Connected with the educational purpose of the paper we have published several charts which form transparencies of locomotive and car drawings showing every part duly numbered, to which names are attached on the margin. These charts have been exceedingly popular. A new chart of a consolidation engine showing the Walschaerts valve motion is now ready. A few months ago we published a small book of pocket size called "The Railroad Men's Catechism," which is very well adapted for railroad officials and for the men who have to pass examinations. The officials use it as a basis for putting practical questions, while the men use it for acquiring the information necessary to answer the questions. A variety of other educational books written in an elementary style have been published by the company.

Testing Hardness of Materials.

Every mechanic or engineer who handles the materials of construction is interested in knowing with accuracy the exact hardness of the material worked upon. Many attempts have been made to devise apparatus that would show with exactness the degree of hardness, not only of steel, but of all other material used for any engineering purpose. Time after time promising appliances were developed, but after real work was given them to do they proved worthless, and the ancient file came again into favor.

It seem now, however, that an accurate and reliable apparatus has been perfected by Albert F. Shore, who describes in the *American Machinist* his appliance and the results achieved. The invention originated with Dr. Herould, a French metallurgist, but was completed by Mr. Shore. The article says that Dr. Herould's theory called for a drop hammer having a given weight and fixed area to the striking point, which bears such relation to the weight that the hardest steel shall be slightly indented by the impact of the fall. Many experiments were made thus, and it was eventually found that it required a force of no less than 75,000 lbs. per square inch to compress hard steel to a slight degree.

Strange as it may seem, this enormous pressure could be obtained by dropping a hammer weighing only 40 grains from a height of 10 inches, by merely reducing the area of the point if it was convex on the tip. In the outset this scheme worked very well, but it was soon found that the point would flatten, hard as it was; here arose the capital problem in construction that, for a time, gamely defied solution. But the intimate knowledge of the behavior of metals under stress, as gained from the device so far as it was perfected, was soon instrumental in causing a new discovery in the treatment of steel, which practically gave it jewel hardness consistent with toughness as well. This assured the successful construction on a successful scientific principle, and the instrument was named scleroscope, from the Greek words *sclerotus,* meaning hardness, and *scope,* because it is direct reading.

In construction the scleroscope is provided with a nickeled hardened-steel anvil base which is secured to a hard-brass tripod having three adjusting knurled-head screws as legs for leveling up by means of a steel-rod plumb bob. This bob is hung on the right side of the glass tube case, while on the left side is a stay rod which not only strengthens the tube case, but is used as a slidable lens holder. The ball or plunger slides loosely within the graduated glass tube and is returned to its starting position at the top by a small rubber suction bulb which is pressed and then suddenly released. When the hammer is thus drawn to the top, it is caught by a pin having a piston in a small cylinder, and a spring which serves to grip the hammer.

EFFICIENCY.

Numerous discussions have been raised by practical engineers as to the efficacy of a glass tube to guide the touch hammer, owing to the friction on its walls, which may be more or less at one time or another; but long practice has shown that such is not the case, even though the tube is not held perfectly plumb. In point of fact, a weight will rebound higher inside of a glass tube than it would in the open, owing to the perfectly straight line in which it falls; it is also apparent that although the tube walls are highly polished to reduce friction to a negligible degree, the air currents between the tube and plunger practically prevent actual contact at any time. In measuring lead, the rebound is but 1½ per cent. of the fall, while in very hard steel it is 73, and over 85 per cent. for strong glass.

SCALE OF HARDNESS.

In preparing this scale, great care was used to insure uniform applicabil-

MAILING DEPARTMENT OF RAILWAY AND LOCOMOTIVE ENGINEERING, NEW YORK.

ity to all metals in general use, so that the measurement of any one will at once show in numbers how it compares with hard steel or soft brass, which average about 100 and 10 respectively. One hundred has been accepted as the standard for steel and also the whole hardness scale for two reasons. Carbon steel hardens from 90 to 110 in general practice, according to the percentage of carbon and the absence of impurities, and most commonly to 100, while that is also the best safety limit for steel tools after they have been reheated and tempered ready for use. With this as a standard, other metals will show the following hardness:

Lead, cast	2
Babbitt metal, cast	4 to 9
Brass, soft, cast	7 to 10
Brass, hard, cast	20 to 25
Brass, rolled	26
Gold coin	14
Copper, rolled	14 to 20
Zinc, rolled	20
Zinc, cast	8
Nickel, cast	27
Silver coin	34
Iron, hot rolled	18
Iron, cold rolled	35
Iron, gray, cast	39
Iron, gray, cast, chilled	50 to 90
Steel railroad rails, 0.45 to 0.50 carbon, annealed	26 to 30
Steel, tool, 1 and over, carbon annealed	31
Steel, tool, 1 and over, carbon unannealed	40 to 50
Steel, tool, 1 and over, carbon cold-rolled drill rod	35 to 40
Steel, tool, manganese self-hardening	60 to 85
Steel, high-speed	100 to 105
Steel, tool, carbon	90 to 110
Porcelain	120
Glass	130

NOTE.—These figures are subject to slight variations owing to the nature of the composition or compression of metals.

On November 10 the Boston *Globe* published a map showing the railroads in Massachusetts, with the names and locations of 101 separate railroads that have been gradually consolidated into two companies.

Grand Trunk Mogul.

The Baldwin Locomotive Works have recently delivered to the Grand Trunk Railway of Canada fifteen Mogul or 2-6-0 type locomotives, which were built to drawings furnished by the railway company. The engines can exert a tractive power of 28,070 lbs. Four similar locomotives have also been built for the Detroit & Toledo Shore Line. These locomotives are examples of a type which, for many years, has been doing efficient work in freight service. The design is compact and parts are readily accessible, and a large proportion of the total weight is available for adhesion. For general freight service, where the demands for steam are not too exacting, the Mogul type is very satisfactory.

The cylinders of these engines are single expansion, 20 x 26 ins., equipped with balanced slide valves. The Stephenson link motion is employed and the rocker shafts are connected directly to the link blocks. The driving wheels are 63 ins. in diameter and carry a weight of 146,200 lbs. This gives a ratio of adhesion of 5.2. The total weight of the engine is 169,160 lbs., and by this distribution of weight the engine truck supports 22,900 lbs. The weight of the engine and tender together amounts to about 290,000 lbs.

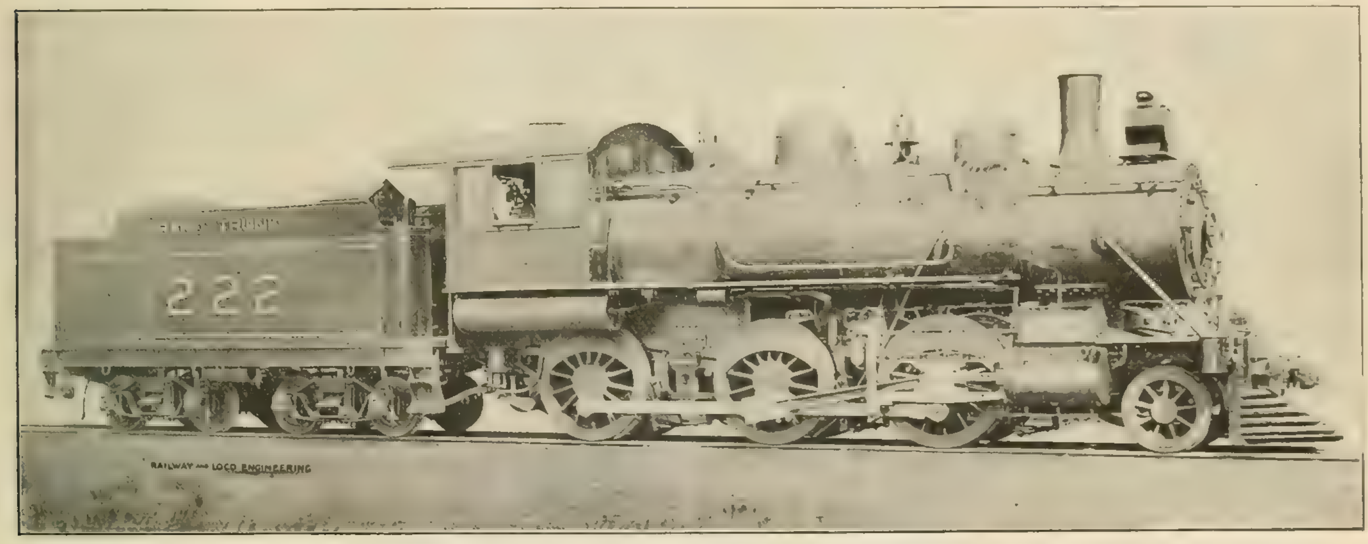
Cast steel is used for the engine frames, crossheads, driving-boxes and main wheel centers. The front and back wheel centers are of cast iron, as are also the crosshead shoes, which are tinned. The guides are of the two-bar type, of wrought iron, case hardened. The equalization system is arranged with all springs underhung. The equalizing beams and frame supports rest directly on top of the springs, and are held in place by pins. The forward equalizing beam rests directly on top of a transverse equalizer, which is carried on the forward driving springs.

The boiler is of the wagon top type with a relatively long firebox and short tubes. The longitudinal seams in the barrel are butt jointed and sextuple riveted. The firebox is radially stayed and a sufficiently deep throat is obtained by sloping the engine frames downward between the main and rear driving wheels.

The heating surface contained in tubes and firebox amounts to 1941.4 sq. ft., made up of 188.1 in the firebox and 1753.3 sq. ft. in the tubes. There are 283 tubes in the boiler, each 11 ft. 11 ins. long, 2 ins. outside diameter and ⅛ of an inch thick. The grate area is 33.43 sq. ft., and this gives a ratio of grate to heating surface as 1 is to 57. The engine is a neat looking though plain design. The general details and finish are in accordance with specifications furnished by the railway company. The principal dimensions of the design are given below:

Boiler—Material, steel; diameter, 62 ins.; thickness of sheets, 21/32 ins.; working pressure, 200 lbs.; fuel, soft coal; staying, radial.
Firebox—Material, steel; length, 120 ins.; width, 40⅜ ins.; depth, front, 76¾ ins.; depth, back, 65 ins.; thickness of sheets, sides, 5/16 in.; back, ⅜ in.; crown, ⅜ in.; tube, ½ in.
Water Space—Front, 4 ins.; sides, 3½ ins.; back, 4 ins.
Driving journals, 9½ ins. by 12 ins.
Engine Truck Wheels—Diameter, 38 ins.; journals, 6½ ins. by 10½ ins.
Wheel Base—Driving, 15 ft. 8 ins.; total engine, 24 ft. 3 ins.; total engine and tender, 51 ft. 1 in.
Tender—Wheels, diameter, 34 ins.; journals, 5½ ins. by 10 ins.; tank capacity, 6,000 gals.; fuel capacity, 10 tons; service, freight.

The New York City Railway Company, a very soulless corporation that operates most of the street railroads in New York City, makes the charge that their car conductors make on an average thirty-five dollars a week by the knocking-down process.



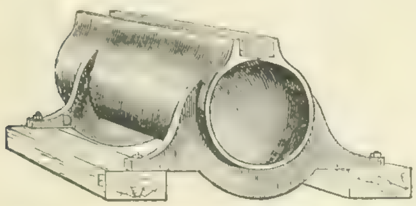
MOGUL FREIGHT LOCOMOTIVE FOR THE GRAND TRUNK RAILWAY.

W. D. Robb, Supt. of Motive Power. Baldwin Locomotive Works, Builders.

A Forgotten Railway.

In the early days of railways, if we may so speak of the years before Queen Victoria came to the throne, the locomotive did not have things all its own way. There was a plan tried in England about 1834 by which railway trains were moved by the pressure of the atmosphere acting on a piston moving through a long continuous cylinder. The plan was successfully worked out, but was finally abandoned by reason of the difficulty of keeping the cylinders thoroughly air-tight at all seasons.

The Atmospheric Railway, as it was called, was a railway similar to the steam railroads of those days, upon which coaches were run. A series of cast iron



TUBE LAID ALONG STRINGERS ON TIES, BETWEEN THE RAILS.

cylinders each about 9 ft. long were bolted to the ties, in the center of the road between the rails. The sections were all carefully aligned and neatly jointed, so that the whole formed a continuous tube, from one end of the line to the other. The tube had a narrow slot along its upper edge and a pair of upright flanges ran along each side of the slot. The upper part of the tube between these upright flanges was made flat and a continuous strip of leather, well greased, was laid along so as to close the opening, and when the leather strip was down in place the tube was practically air tight.

Inside the tube was a piston, fitting it closely. The piston-rod was hollow and extended back several feet behind the piston. At this point it was turned up at right angles to the axis of the tube and came out of the slot. Just above the slot the hollow piston-rod was divided so that it passed up on each side of the leather strip, and became one pipe again, a little higher up. By this arrangement the leather strip passed through the upright portion of the piston-rod, and was carried upon a little roller placed in what we may call the eye in the piston-rod. The rod, however, was a continuous hollow tube through which air might pass when desired from the outside, through the piston-rod and the piston into the interior of the long continuous tube.

The upright portion of the piston-rod was attached to the leading coach of the train and when the piston moved along through the tube, the coach was moved along the rails. Pumping stations were placed at points three miles apart along the line and these were equipped with pumps which continually exhausted air from the tube. In this way a partial vacuum was formed in the tube, always in front of the piston and the atmospheric pressure in the tube behind it forced the piston to travel along the tube and so propel the attached coach which drew the trailers.

As the piston moved along, the partial vacuum held the leather strip down on the slot in front of the piston. It was, however, raised by the upright portion of the piston-rod, and in fact it was lifted and laid by passing over the roller in the eye. The opening of the slot was thus always behind the piston, and the air which here entered the tube, assisted in keeping full atmospheric pressure constantly behind the piston, while the pumps drew out the air in front of it. The tube was, of course, open at the end away from which the piston was traveling.

The Atmospheric Railway promoted by Mr. Pinkus was at one time a reality and was operated between New Cross and Croyden, near London. Our illustrations and the facts from which this brief description is drawn are taken from the "World of Wonders," published many years ago by Cassell, Petter and Galpin of London.

The object of the hollow piston-rod extending up into what they then called the "piston coach" was to give the guard control of the train. The guard could, by opening a valve, admit air to the hollow piston-rod, and the air flowing down it and through the piston into the tube, reduced the vacuum in front of the piston and thereby partially equalized the pressure on each side of the piston, with the result that the speed of the train was slackened. It seems probable that with the guard's valve fully open and brakes tightly set, the train could have been entirely stopped if desired. There is, however, no direct information before us on that point. It is also probable that at the end of the trip the piston was run out of the long tube and reversed for the return journey. It is, however, certain that as only one train could be operated at a time no collisions could possibly have taken place on the Atmospheric Railway.

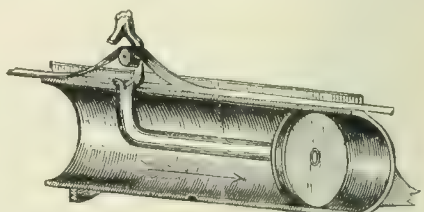
A modification of the slot closing apparatus, which was also tried, consisted in making the leather strip in short sections, weighting it with band iron on the top and hinging each section of leather to one of the upright flanges beside the slot. With this arrangement the hollow piston-rod did not have an eye, but was shod with a sort of ploughshare, which, as it passed along, turned up the hinged sections of leather one by one behind the piston, and the weighted leather closed after the rod had passed.

The failure of this curious form of railway seems to have been owing to the great difficulty in keeping the slot-closing device in thorough working order in all kinds of weather. The conception of road and the detail in which it was worked out shows that it was not merely an enthusiast's dream. It is a matter of record that the road was successfully operated for a time, and the whole enterprise forms a most interesting though forgotten chapter in the eventful history of land transportation by rail.

Waste Caused by Accidents.

A friend of the American Museum of Safety Devices and Industrial Hygiene has offered a prize of $100 for the best essay on the Economic Waste Caused by Accidents. The Committee of Award consists of Messrs. Richard Watson Gilder, George Gilmour and W. H. Tolman.

Prof. F. R. Hutton, past president of the American Society of Mechanical Engineers, is the Chairman of the Committee on Admission of Exhibits for the American Museum of Safety Devices and Industrial Hygiene, which occupies the entire fifth floor at 231 West Thirty-ninth street, New York. The museum desires exhibits of devices and processes for safeguarding life and limb in connection with wood-working machinery, railway and marine transportation, mining, agriculture, manufacturing of all kinds. One exhibit already consists of specimens of 50 different kinds of dusts illustrating the occupational diseases; accompanying each is the photograph, a microscopic section of the lungs, showing the effect on



ATMOSPHERIC TUBE WITH PISTON CONNECTION AND LEATHER SLOT CLOSER.

the worker of coal, iron, brass, steel, wood and other dusts. There are also wax models of lungs and hands illustrating those occupational diseases which attack the bones and skin.

All exhibits accepted by the Committee on Exhibits will be eligible for the gold medal offered by the *Scientific American* for the best device, exhibited at the museum, for safeguarding life and limb. All inquiries regarding exhibits should be sent to Dr. W. H. Tolman, Director, 231 West Thirty-ninth street, New York, who will furnish full particulars in regard to this admirable institution which has already met the warm approval of the leading scientists and philanthropists in America.

General Correspondence

Holding the Held Special.

Editor:

This picture of the Anna Held Special on the Colorado Midland was taken at the west entrance of "Hell Gate" by W. W. Buckwalter, of Denver, Colo. The name "Hell Gate" was applied to this piece of country by the early explorers, prospectors and hunters, as it was almost impossible to get through this region afoot. There are about three miles which for grandeur of rugged, rough and wild scenery, rivals any part of the world. The most eminent travelers of the globe declare it is second to none. To appreciate it thoroughly it must be seen. Tourists to Colorado or the Pacific Coast should by all means see it by daylight. They would miss much of typical Rocky Mountain scenery should they fail to take in this wonderful work of nature and ingenuity of American engineering. In running the lines for the Colorado Midland it was necessary to lower the surveyors from above with ropes. It took months of labor and tons of dynamite to blast away the huge rock boulders and clip to obtain the solid granite roadbed over which trains run, as the entire roadbed is on solid granite. The guard rails shown in the picture are an extra precaution, for in case a car should be derailed it could not leave the track far enough to fall over the precipice. Every precaution is taken to insure absolute safety to trains over this piece of track, and the air brake equipment is second to none in the world. I have been running over this piece of track for years and never make a trip but I see something new, some freak of nature, something to wonder at. The Colorado Midland traverses the very heart of the Rockies.

F. STIFFLER,
Basalt, Colo. Engineer.

Profits by a Dream.

Editor:

The following story of a dream was given to me by a gentleman who had as was admitted, great ability and was universally liked yet failed to rise in position as his merits would seem to warrant. He not only had a dream, but like the kings of old he was able to interpret it and apply the moral, and he after that greatly profited thereby and his progress was rapid thenceforth. I send it thinking that you could use it in one of your corner paragraphs of morals that you use sometimes. This is the dream:

The gentleman who had great ability but did not rise in the world one night had a dream as follows: He had been hunting all day and quite unsuccessfully, was walking home on a railroad track, when a passerby called his attention to a game bird a short distance away that was about to fly; his gun was unloaded, and before he could put the ammunition in gun the bird had flown. A short distance further he saw a rabbit near the track; the gun still unloaded, he hastened to load the gun; the ammunition being strapped in a bag, he hurried to get it out, the rabbit in the meanwhile playing near by; just as he was about to load the gun the rabbit took fright and ran across a field, here a watchful dog took up the chase and soon captured it.

In the morning every detail of the dream was very clear in the man's mind, and as he thought it over he saw there was an application of his vision that referred to himself. The gun was himself strong and accurate but unless without ammunition, the ammunition in the bag, his abilities locked up, and when wanted took so long to get it that the opportunity was past before the gun and powder could be brought together. In other words, when an opportunity presented he was not ready to take advantage of it and opportunity (bird and rabbit) escaped. He took it seriously and surprised all that knew him by his rapid progress thereafter.

Dubuque, Ia. GEO. H. BROWN.

THE "ANNA HELD" SPECIAL ON THE COLORADO MIDLAND, SPECIALLY HELD.

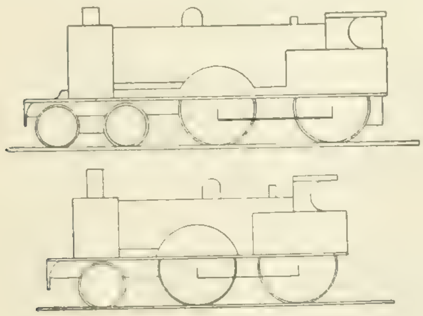
Concerning English Locomotives.

Editor:

The variety of types of locomotives in use on British railways to-day is greater perhaps than could be found in any other country. Some of the oldest engines still in active service date back as far as the fifties, but, needless to remark, they have been rebuilt a number of times since they took their maiden trip. When an engine begins to show signs of decrepitude, instead of being relegated to the scrap heap or shifted into switching service, it is sent to the shops, the worn parts replaced by new ones, a fresh coat of paint administered, and sent back to its former service, and good for a number of years.

When an engine is rebuilt [illegible] brass

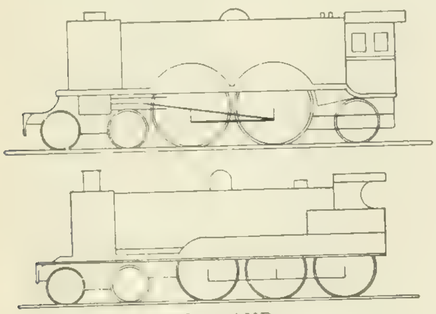
plate is fastened to the side of the smoke box or wheel guard, giving the date of rebuilding and the name of the shops where the work was done.



FIGS. 1 AND 2.

The writer noticed on a recent trip through the British Isles, an engine that was rebuilt in 1881. Twenty-six years ago. How many years prior to that date it was constructed of the raw materials is a matter of speculation.

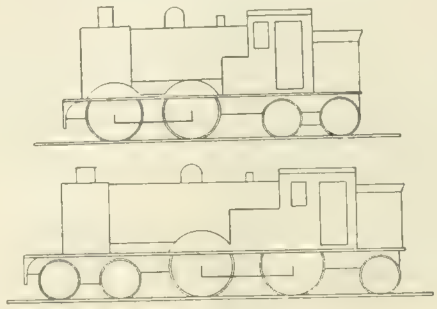
British locomotives have many arrangements of drivers and trucks, as will be seen from the twelve accompanying diagrams. The most popular engine and of the type that can be seen in greatest numbers and which is used principally for passenger service, is shown in Fig. 1. The engine shown in Fig. 2 comes second, but is becoming confined to the branch lines and lighter service, although quite a number are still in use on the main lines. They are used sometimes to make up one of the two engines on double header



FIGS. 3 AND 4.

trains on account of their lighter weight, because it is against the regulations of the railway companies to double head a train with two of the heavier engines together. The Atlantic type of engine shown in Fig. 3 is becoming very popular on some of the roads, notably the Great Northern and the North British. These engines are among the largest in the British Isles, and some of them used on the North British railway have so nearly reached the limit of height with the top of the boiler that the smokestack is exceedingly squatty and gives the engine a very peculiar appearance. The ten-wheel type of locomotive shown in Fig. 4 is used considerably for both freight and passenger service, the freight engines having drivers of about sixty-six inches diameter and the passenger engines from seventy-two to seventy-six inches. This type of engine is used in considerable numbers on the London and North-Western, the Caledonian and on the Glasgow and South-Western railways, but is not as popular as the three previously mentioned types of engine.

The type of engine shown in Fig. 5 is seen in large numbers and is con-

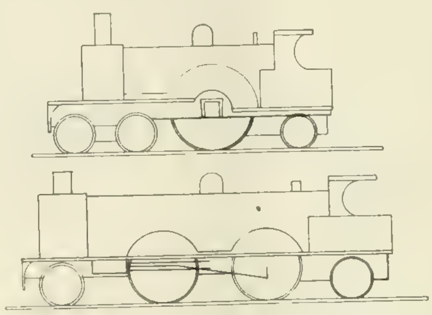


FIGS. 5 AND 6.

fined principally to short runs and to suburban service in the vicinity of the larger cities. These engines run with drivers first and truck following, or vice versa, according to the direction of the train. Fig. 6 represents a popular type of tank engine used chiefly on the London and North-Western Railway for short runs.

Contrary to the general supposition there are many single wheelers still in use. Figs. 7 and 9 indicate the two types of these engines. Some of them are inside connected and some are outside connected, and they are capable of maintaining high speeds for a considerable distance when attached to comparatively light trains.

Some of the express trains on the

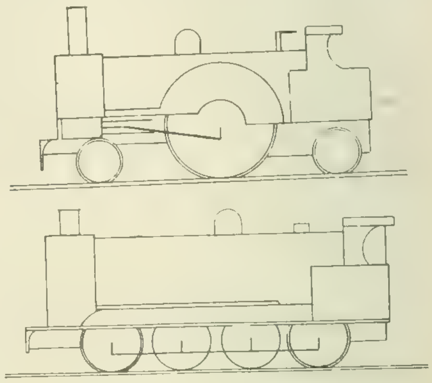


FIGS. 7 AND 8.

Midland Railway between London and Manchester, which consist of from five to six double truck, corridor cars, are pulled by this type of locomotive. With the exception of a few miles of hilly country near Manchester, one engine only is used, and it covers the distance, two hundred miles, in three hours and a half, with two stops. The drivers on this type of engine range from seven feet six inches in diameter to nine feet. Those of the Midland Express engines are seven feet and six inches.

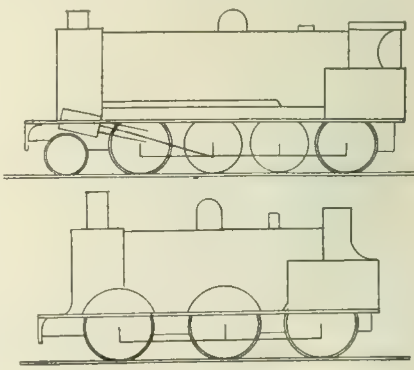
The engine shown in Fig. 8 is not a very prevalent type. It is an interesting one, however, from the fact that it is compound and that the drivers act independently of each other. The high pressure cylinders are outside, connected to the rear drivers and the inside cylinders, sometimes only one cylinder, is inside, connected to the front pair of drivers. It is an odd sight to see these engines on a grade with first one pair of drivers slipping and then the other and sometimes both together at a different speed.

Figs. 10 and 11 represent the prevailing types of freight or goods locomo-



FIGS. 9 AND 10.

tives for heavy service. These types are both inside and outside connected. The type of locomotive in Fig. 12 is seen on nearly all the roads and is used in branch line passenger service as well as for pulling freight trains. These engines belong to a past regime, but many of them are still in good repair and doing excellent work. To the above mentioned types of present day locomotives might be added the "decapod," or locomotive with no truck and five pairs of drivers. These are very few in number and are only used for heavy service. There are many four-wheeled, light and compact locomotives in use for handling from one to two cars in



FIGS. 11 AND 12.

suburban service. Some of these little engines are attached directly to the car and make up what is known as the steam motor car. Others are detachable, like an ordinary locomotive, and

none of them can be used for other than very light loads.

The great majority of English locomotives are inside connected. Some of the Atlantic type, notably on the Lancashire and Yorkshire Railway, have inside connections and nearly all the ten-wheelers are arranged after this fashion.

E. C. LANDIS.

Nashville, Tenn.

Electrification on the West Shore.

Editor:

Between New York and Buffalo the New York Central Railroad owns or controls two separate lines, one a four- and the other a two-track route. The double-track road, or as it is called, the West Shore, parallels the main line the entire distance, except at one point, that is, between Utica and Syracuse. Between these places the West Shore is seven miles shorter. For a number of years the West Shore has given a very inefficient passenger service, there being only two passenger trains a day over some divisions. A few years ago an electric line was proposed between Utica and Syracuse, paralleling the West Shore. This line if running a frequent train service would seriously interfere with the West Shore's business in that section, which contains a number of villages, and is a thriving farming section. To stop this possible competition, the Central decided to electrify that division of the West Shore. For that purpose they leased it to the Oneida Railway Company, reserving the privilege, however, of running their steam trains over the division.

ELECTRIC TRAIN ON THE WEST SHORE.

The cars are run into each city over the city lines, and as these are equipped with a 600 volt trolley system it was a question with the management whether to adopt for the main line the single-phase system or direct current, the cost of both systems being about the same. For this reason and also because the single-phase system was at that time (June, 1905) new and untried, they decided to adopt the direct current. On account of its being cheaper they also decided to adopt the third rail in place of the overhead catenary construction for trolley and to use the same voltages as the city lines.

Power for the operation of the road is purchased from the Hudson River Power Company, which delivers it at 60,000 volts, three phase and 40 cycles, at the Clarks Mill sub-station. This is one of four sub-stations located about ten miles apart. These reduce the high tension current to the 600 volts required by the road. From the sub-stations the current is led through an underground duct to the third rail.

This third rail is of the double headed type and is of the same composition as the standard type. The joints are made with an ordinary splice bar over which the bonding is placed. The track is also bonded. The third rail is protected by a wooden sheathing which covers the top and sides, but allows about a half inch of the bottom of the rail to project. At first a fiber covering was tried, but on account of its cracking it was given up as impractical. The third rail is supported by cast iron brackets which are placed ten feet apart. These are insulated from the rail by semi-porcelain blocks, which are clamped directly upon the rail, the wooden coverings being cut away for that purpose. At highway crossings and other points where the third rail would be impossible, pipes are laid underground and the current carried through them by means of copper cables. These cables connect the ends of the third rail. This road differs from the electrified section on the Central in the fact that there are no overhead wires at crossings, the cars being carried across by their momentum.

ELECTRIC EQUIPMENT ON THE WEST SHORE RAILROAD.

As the cars are operated on the city tracks they are made smaller than if they were to operate on the West Shore exclusively. They are 48 ft. long, 8 ft. 4 ins. wide, and 13 ft. high, and will comfortably seat fifty-two people. The trucks used are the Brill with a wheel diameter of 37 ins. They are equipped with four General Electric No. 73 motors with the Sprague-General Electric control. Westinghouse automatic air brakes with graduated release and Smith hot water heaters are used.

The road is protected by the latest type of controlled manual block signals. On some sections third and fourth tracks have been added. At present an hourly service is maintained. The cars make the run between the city limits, 43 miles, in a little over an hour. Up to the present no one has been injured by contact with the electrified rail, but there has been one death caused by contact with the high tension wires.

W. M. DE WITT.

Vernon, N. Y.

Too Many Wheels.

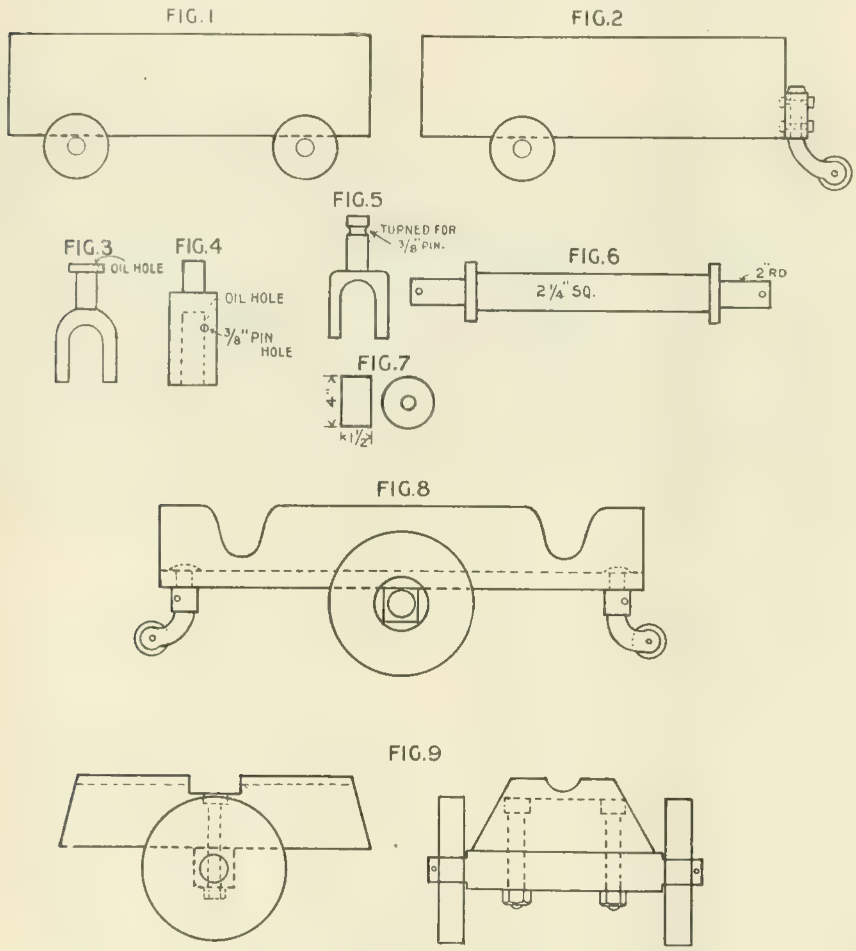
Editor:

What would the designer or draughtsman or high functionary responsible for this handy help to humanity think of a conversation such as follows? It contains criticism, however, and may be of use, so I give it:

"An' sure, Dutchy, phy the divil don't ye lift up wid that bar an' slew yer end over? Bejabers, this cart reminds me of a horse I once owned, for as long as he wint straight he was a darlint,

but the divil of a corner would he turn, and begorra, we had to get out and blindfold him when we did. Bedad, it takes forty man power wid bars on skids to slew this cart aroun' wid a load on." The big, red-faced Hibernian looked at his Teutonic helpmate with weariness and despair.

"Vell, I dink it is petter ven ve got some more hellup un a stout mule vot turn de corners un go aheat. Py Chiminy, it woot pe a goot ting ven dey put somdink like a merry-go-round, every



TOOT'S SHOP WAGON, GOOD FOR SHARP TURNS.

vonce in while, to turn dis ting on. Mein Gott, but mine pack is broked mit lifting dot grosse ting." The Teuton felt himself in a comical way to see if he was still whole, and stared at the Irishman with a worried look on his face.

"Sure, Dutchy, don't worry. Take the dewice of an ould stager. So bejabers, take it aisy an' don't be spiling' yer buty by worriting."

I had been an interested spectator of this scene in one of the largest foundries in the country which I was looking over at the time, and could not but wonder at the shortsightedness of proving a convéyance such as the two men had under discussion. I show the truck in Fig. 1, and have seen the same kind in other shops, but in th's case there was a great many heavy castings and parts of machinery to move around, and while they had electric cranes and every device a modern shop should have to handle their output, there were still nooks and crannies they don't reach. The little four-wheel rigid truck shown in Fig. 1 had to be used to reach these nooks and crannies, so while it answers admirably for going in a straight line even with a heavy load, it requires to be slewed around a corner with bars or there must be men enough around to lift the truck and load bodily when a turn is made.

I did not wonder at all at the wrath of the broad-shouldered Hibernian and the corpulent Teuton, but wondered at the indolence of the designer in letting the matter go when a slight change would have helped matters wonderfully and called down the blessings of Pat and Hans on his head instead of harsh words.

The change I speak of is shown in Fig. 2 and is simply to take out a pair of wheels and substitute one wheel at the back of the truck. This little wheel moves in a complete circle. Fig. 3 shows the third wheel and the correct shape of the forging to suit. It is fastened to the body of the truck with cast iron boxing, bolted to the body. Such an arrangement has so many advantages over a rigid-frame truck that it is almost useless for me to enumerate them, but the greatest is the short space the car can be turned in, in cramped quarters. The improved car can be used in places where the style shown in Fig. 1 would be useless.

A truck for handling mounted wheels in repair sheds can be made on the same plan and will be found very handy in trucking them between lines of cars, and it has the advantage of saving the shifting of the cars when wheels and axles are changed.

A 12-in. channel of the required length forms the body of the truck, with a 2¼-in. axle bolted to the middle with 14-in. wheels. Fig. 4 shows the sleeve for the forks, and Fig. 5 the fork, Fig. 6 the axle, Fig. 7 the roller, and Fig. 8 the truck complete. It is not a bad idea to cut notches in the channel, as shown, for the flanges of the wheels, as the wheels are more easily got off and on the truck. The sleeve is riveted to the channel through a square hole made to conform to the squared portion of the sleeve. There is a 2-in. space left on the front and rear rollers, from the floor, as shown in Fig. 8. This is an advantage when shifting to the right or left, and makes the truck and load be handled easier.

A simple truck for handling axles is shown in Fig. 9, which consists of two 16-in. wheels and a 1¾-in. axle with a block of wood bolted to the axle. The block is V-ed lengthwise and a V is cut across the middle to leave space for the grab hooks to clamp the axle while on the truck. Otherwise the axle has to be lifted up, and this is unnecessary if the truck is properly made. Any one can build these trucks, but every one don't think to provide oil holes for the wheels. It is a small item but an essential one, as a drop of oil in the right spot will do wonders, sometimes.

St. Louis, Mo. T. Toot.

Curious Flow of Steam.

Editor:

In a letter under the heading, "Slipping While Shut Off," in your November, 1907, issue the writer says he is about to believe nothing is impossible at this time and that engines do queer things.

Recently I was on a run which required me to lay at the terminal away from home each alternate night. At the terminal the round house was kept quite clean and was warmed by large stoves and was made very comfortable to spend an evening in. After eating our lunch we would read the paper and discuss the technical questions seen in Railway and Locomotive Engineering. After the engine was backed into the house, throttle closed and fastened,

lubricator shut off; in fact, all valves and pipes leading to the cylinders closed, the night watchman would fill the boilers full until the injector would break. When the injector broke a violent rush of steam would come from the cylinder cocks which would last about fifteen seconds. I would like to ask why this rush of steam with all valves closed?

One word about the slipping shut off. The idea to me is not unreasonable or impossible. I knew an engine that it was claimed did that peculiar thing. The engine was in first class condition. Her counterbalance was perfect, valve motion good. It was an engine that was very swift and it was rumored that there was no end to her speed. I observed the slipping took place when the station stop was being made. The tires were extremely hard and her drivers slipped very easy. In making the station stop frequently the driver brake would not set; naturally that allowed the drivers to run free. As the train brake would take hold the speed of the train would be slackened, the drivers being free. Their momentum would not be checked and their weight would cause them to slip for a few seconds until the friction on the rail would stop them. ENGINEER.

Grand Rapids, Mich.

[We would like to hear from any of our readers about the blow from the cylinder cocks. In the matter of slipping shut off, it seems to us a better expression would be imperceptible skidding when shut off, as the wheels probably drag slightly along the rails. We do not think our correspondent is quite correct in his explanation. If he is right, then any engine truck wheels without brakes should slip in the same way when the engine is coming to a stop. The probable explanation of this phenomenon is as previously given on page 489 of our November, 1907, issue. —ED.]

The Mayflower on the Old Colony.

Editor,

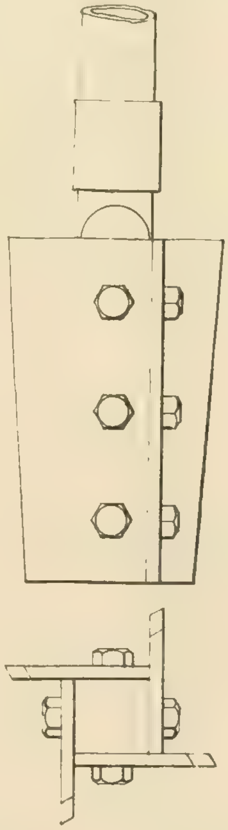
For a long time I have tried to obtain a picture of one of the Old Colony locomotives, as I knew them when a boy. Therough the kindness of Mr. Henry W. Scott, of the New Haven road, I am able to send you for reproduction a photograph of the "Mayflower," showing the smoke stack used by that road in the sixties. In RAILWAY AND LOCOMOTIVE ENGINEERING for November last, Mr. Geo. H. Brown gives a table of dimensions of the early engines and tells us that the "Mayflower" was built by John Souther in 1848, weighed 44,600 lbs., had cylinders 15 x 20 ins., and ran until 1870. HERBERT FISHER.

Taunton, Mass.

Exhaust Nozzle Reamer.

Editor,

The accompanying sketch represents a reamer for cleaning the exhaust nozzle of a locomotive without opening the front end. The reamer is fastened to a long 1-in. pipe with a tee at the end through which a bar is placed to turn the reamer. It is placed in the exhaust nozzle through the stack. The reamer is made of such a size and shape that it will clean the exhaust nozzles of all the engines running into the Oakland terminal of the Southern Pacific Company. W. W. UPDEGRAFF.



EXHAUST NOZZLE REAMER.

Fruitvale, Cal.

He was a keen student of men who said: "There are often more signs of dyspepsia than justice in a criticism."—*Anon.*

OLD COLONY LOCOMOTIVE "MAYFLOWER."

Strength of Boilers.

Editor:

In the November issue of RAILWAY AND LOCOMOTIVE ENGINEERING, J. D. asks a question in regard to the safe working pressure of boilers. In the following article I shall try to explain some of the questions entering into this problem, which is so important in locomotive construction.

For illustration we shall take a 72-in. boiler, with plates ⅜ in. thick, the steel having a tensile strength of 60,000 lbs. per sq. in. First consider the shell to be made of one piece of steel, without joints. As the pressure is stated in pounds per square inch, the length of the boiler does not affect the problem, and a section of the boiler 1 in. long, forming a ring or hoop, is used in calculations. As a matter of fact, the pressure acts at right angles to the surface of the boiler all the way round, but, as far as bursting the shell is concerned, the effect is the same as though it acted on a flat surface through the center, thus pushing one half away from the other.

In the ring of our boiler the pressure acts upon a flat surface 1 in. wide and 72 ins. long, and the two halves of the ring are held together by the resistance of the metal on each side. This metal is ⅜ x 1 in., which equals ⅜ sq. in. for one side and ¾ sq. in. for both. The resistance, or tensile strength of the metal is 60,000 lbs. per sq. in., or $\frac{3}{4} \times 60{,}000 = 45{,}000$ lbs. holding the ring together. In order to overcome this resistance and burst the shell the steam must act on the diameter with a total force of 45,000 lbs. As the diameter is 72 ins. long, the pressure on 1 in. is 1/72 of 45,000, or 625 lbs., which equals the bursting pressure per sq. in. for the boiler.

The pressure required to break one side of the ring is $\frac{3}{8} \times 60{,}000 = 22{,}500$ lbs. Multiplying this by 2 and dividing by 72 we get 625 lbs., the bursting pressure. Therefore, to find the bursting pressure, multiply the area of a section

of the shell one inch long by the tensile strength of the metal; multiply the result by 2 and divide by the diameter of the boiler in inches.

Multiplying the diameter by the bursting pressure we get 72 × 625 = 45,000 lbs. Dividing by 2 gives 22,500 lbs., the force required to break one side of the ring. Therefore, to find the strain on the shell, per inch of length, for any given pressure, multiply the diameter in inches by the pressure and divide by 2, or multiply the radius of the boiler by the pressure.

We found the bursting pressure to be 625 lbs. per sq. in. As a matter of precaution this is divided by a number called the factor of safety, to obtain the safe working pressure. Divide 625 by 5 and we get 125 lbs. per sq. in. as the safe working pressure. The factor of safety varies with different designers, but 5 is a good general average. Aside from giving a suitable margin of safety, it is intended to provide for various things which may weaken the boiler, such as poor workmanship, imperfections in the material and the corrosion of the shell.

In the example we have just worked out, the boiler was supposed to have been made of one sheet. As a locomotive is made of several sheets riveted together, allowance must be made for the strength of the riveted joints. There are three principal forms of riveted joints: the lap joint, in which the two plates overlap each other; the butt joint in which the edges of the plate are brought together and held in position by a narrow strap covering the joint and riveted to both plates, and the butt joint in which two straps or welts are used, one on each side of the plate. riveted joints are either single, double, or triple riveted, depending on the number of rows of rivets which are used.

To give an idea of the principles involved in finding the strength of riveted joints, we will take a single riveted lap joint. This is not used at all in modern locomotive practice, but for sake of example let us take one with 1-in. rivet holes spaced 2⅛ ins. apart, and determine first whether the joint will give way by shearing the rivets or by breaking the plate along the line of the holes. Take a section of the joint equal in length to the spacing of the rivets and including one hole. If the plate were solid, the area would be ⅜ in. × 2⅛ ins. = .797 sq. in., and the strength would be 60,000 × .797 = 47,820 lbs. But the 1-in. rivet hole takes out a space equal to 1 in × ⅜ in. = .375 sq. in., which leaves only .422 sq. in. of plate, with a strength of 60,000 × .422 = 25,320 lbs. Take the shearing strength of rivet iron at 38,000 lbs. per sq. in. The rivet will fill the 1-in. hole when driven and the area will be .7854 sq. in. The shearing strength of the rivet will be 38,000 × .7854 = 29,845 lbs. The joint is no stronger than its weakest part, and as the strength of the plate is only 25,320 lbs., the joint will fail by breaking the plate between the holes. Dividing the strength of the "net section" of the plate by the strength of the solid plate we get 25320/47820 = .53, or 53 per cent. efficiency. This means that if the solid plate would stand a pull of 100 lbs., the riveted joint would stand a pull of only 53 lbs.

If 15/16-in. holes had been used in this case, with the same spacing, the strength of the rivets and plates would have been almost equal, the plate being 26,520 lbs. and the rivets 26,220 lbs. The joint would give way by shearing the rivets, and the efficiency would have been 55 per cent. If ⅞-in. holes had been used the efficiency would have been reduced to 48 per cent.

A butt joint with two straps is much stronger than a lap joint, not only because the rivets must shear in two places instead of one, but because the pull is more direct, as can be seen from a simple experiment. Have a friend grasp a short piece of stick firmly in one hand. Take hold of it close to his hand, with your arm at right angles to the stick, and pull. The tendency is to twist the stick around. Now have him hold the stick in both hands, take hold between them and pull. There is no tendency to twist the stick, and you cannot remove it without breaking it or pulling it through his fingers. The latter action has its counterpart in the boiler joint by the plate crushing out in front of the rivet. The lap joint acts very much as the stick did in the first experiment. The plates are not in a straight line, and under heavy pressure the joint tends to twist around till the plates come so as to bring the pull in a more direct line.

The standard joints recommended by The Hartford Steam Boiler Inspection and Insurance Company have the following efficiencies: Lap joint, single riveted, 56.6 per cent.; lap joint, double riveted, 68 to 74 per cent.; lap joint, triple riveted, 75 per cent.; butt joint, two straps, double riveted, 75 per cent.; butt joint, two straps, triple riveted, 86 per cent.

They are calculated for a tensile strength of 55,000 lbs. for the steel plates and a shearing strength for the iron rivets of 38,000 lbs. in single shear (lap joints), and 70,300 lbs. in double shear (butt joints with two straps). Lap joints and butt joints with a single strap have about the same efficiency.

To return to the boiler in our problem. We found the working pressure to be 125 lbs. Assuming that the seams are triple riveted butt joints, with an efficiency of 86 per cent., the safe working pressure, taking the seams into account, will be .86 × 125 = 107.5 lbs. This method of finding the safe working pressure of the boiler applies only to the longitudinal seams. The strength of the girth seams is calculated in a different way, as they are subjected to the pressure which acts on the ends of the boiler instead of on the diameter. They are not considered in finding the working pressure, as it takes twice as much force to burst a boiler along a girth seam as it does along a longitudinal seam.

From what has been said above we see that the safe working pressure of any cylindrical boiler can be found by the following rule: Multiply together twice the area of a section of the shell 1 in. long, the tensile strength of the metal and the efficiency of the joint, and divide by the factor of safety and the diameter of the boiler in inches. Thus: $2 \times .375 \times 60{,}000 \times .86 \div 5 \times 72 = 107.5$ lbs. per sq. in. This is a good general formula to use when it is not necessary to take the staying and flat surfaces into account. The strength of the water legs, crown sheet, and even of the tubes, is a very different question from that of the strength of the shell.

SIDNEY C. CARPENTER.

Plainville, Conn.

Loose Side Rod Bushings.

Editor:

"Bushing is loose in side rod on main pin," together with the designation of the side on which the defect exists. This is a familiar report to those whose job it is to supervise round-house running repairs, especially where heavy consolidation locomotives are in use.

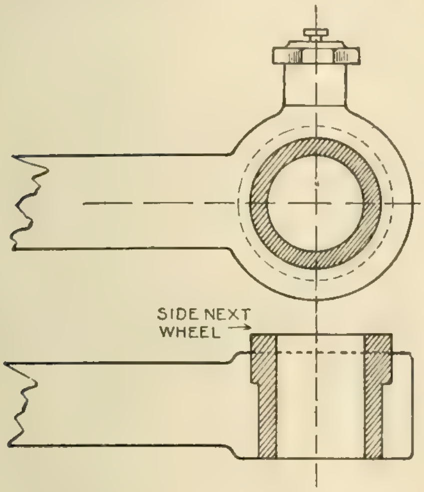
The greatest danger in the bushing becoming loose is that the rod invariably works toward the wheel, or rather toward the crank pin-boss. This destroys the clearance between the side rod and the wheel. Generally the knuckle pin is just flush with the inside of the side rod, but frequently knuckle pins are found projecting beyond the rod, and just as sure as the rod becomes disloged on the bushing it will work inward. Then the projecting knuckle pin catches the crank and the side rods are bent or broken.

Many an accident could be traced to this cause. It is understood that loose knuckle pins working in, will produce similar effects. In such cases it is not only one of the rods that suffers, but usually both sides will be crippled. Cases are known where the counter-balances have broken the rods when

the clearance had been destroyed by the bushing working loose.

To obviate this defect, the writer would offer this suggestion: All bushings in side rods should have a shoulder on the end next to the wheel. That such shoulder should be about one-eighth (⅛) of an inch high and one (1) inch long, and that a corresponding recess be made on the insde of the rod to engage a portion of this shoulder, say five-eighths (⅝) of an inch and three-eighths (⅜) of an inch projecting beyond the rod. This part would insure sufficient clearance between the wheel and the side rod.

The writer has observed the movement of loose bushings for a period of nearly twenty years, and fails to recall any instance where loose bushings on main, or intermediate, pins have worked in and the rod out. It is invariably that the rod works in. The object in view in making the shoulder so long is



PROPOSED SIDE ROD BUSHING.

to prevent it from being sheared off by the side rod.

This method would lessen the degree of danger emanating from loose bushings, if not become a positive preventive. Comparatively small damage will be done by allowing the bushing to revolve in the rod to that which has been described. It will be perfectly safe for the engine to proceed with full train to her terminal where the necessary repairs can be effected.

JAMES FRANCIS.

Carbondale, Pa.

The kick of a mule is dangerous and is certainly painful, but it does not compare in misplaced dynamic effort with a kick given by the starting crank of an automobile. We have twice had practical demonstrations of the misplaced power of our automobile and hope that such form of practical information may never come to us again. No, never!

Handling Driving Wheel Tires.

In the new locomotive shops of the New York, New Haven & Hartford Railroad at Readville, Mass., an unusually convenient arrangement has been made for handling locomotive driving wheels and tires in removing and resetting. The tire house is a separate structure of skeleton steel and corrugated galvanized iron, located in

TIRE HANDLING AT READVILLE ON THE N. Y., N. H. & H.

convenient relation to the erecting floor and the space adjacent to the latter where driving-wheel work is carried on. Suitable space is provided next to this building as a storage yard for mounted wheels, and this yard is served by a 10-ton crane which operates both within and without the building, as shown in the accompanying illustrations.

Within the tire-house is a Ferguson oil furnace, supplied by the Railway Materials Company, of a sufficient capacity to heat a nest of eight tires at one time. In removing tires a pair of mounted wheels is supported by the crane over the ordinary fire until sufficiently heated for removal, when the load is hoisted and the tire struck off. The entire work of handling wheels and tires is exceedingly simple and expeditious.

The dimensions of the building are 56 by 32 ft., and this space, as well as the storage yard, is ample for efficient work.

Staff System in the Rockies.

The system of train operation generally called the staff system has been introduced on a particular portion of the Canadian Pacific Railway. The portion of road is in the province of British Columbia and is on the Pacific Division, of which Mr. F. F. Busteed is general superintendent. Between the stations Hector and Field there are about eight miles of main line, and this is where the road, when one is going west, winds down the Kicking Horse Pass in the Rocky Mountains. The grade is 4 per cent., and when on this part of the road an ordinary passenger coach 65 ft. long will have one end higher than the other by about 2 ft. 7¼ ins.

The staff system is used on the "big hill" to relieve the dispatching and in addition to the safety feature introduced in train operation it facilitates the movement of pusher engines on that grade. The staff machines made by the Union Switch and Signal Company of Swissvale, Pa., are the ones used.

The absolute and permissive systems are employed. The permissive system is only used on eastbound trains or for those ascending the grade. On this grade there are three safety switches, and the up train has to pass the last safety switch before the permissive staff can be taken by the following train.

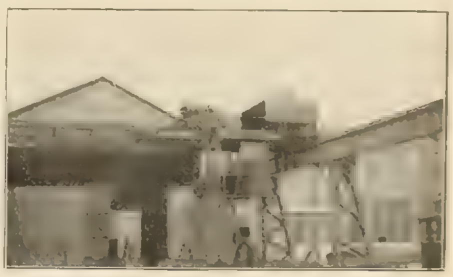
Westbound trains are those going down the grade, and these cannot use the staff until the preceding train has arrived at the bottom of the grade. In other words, the absolute system is alone used for westbound trains.

There is no mechanism employed for catching the staff up. The staff is removed from the machine by the operator and handed to the conductor, or engineer of the pusher engine, who returns it to the operator at the other end of the block, and this man places it in the machine.

A detailed account of the working of the train staff system was given in RAILWAY AND LOCOMOTIVE ENGINEERING, November, 1904, page 492.

Did He Make a Fortune?

An item has been going the rounds of the press to the effect that David P. Proctor, a cousin of Senator Proctor of Vermont, had died in a Chicago lodging house in straitened circumstances. It adds that the unfortunate man made a fortune from the sale of royalties on an in-



TIRE HOUSE AT READVILLE ON THE N. Y., N. H. & H.

vention which he patented in the early 70's—a device to arrest and extinguish sparks from the funnels of locomotives.

Most railroad men would like to know about a spark arrester that brought a fortune to the inventor.

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Defects of Steel Tires.

Speaking of the performance of steel tires in service, Mr. G. L. Norris, the mechanical engineer of the Standard Steel Works, said among other things in a paper recently read before the Western Railway Club, on the subject of "Steel Tires, Causes of Defects and Failures," that during the past few years, owing to increased speeds, wheel loads and severity of service, steel tires have more frequently developed that condition of tread usually called shelly or flaky spots.

Such a condition is in the nature of a breaking down of the tread into flakes or scales by numerous cracks which penetrate into the tire, principally in the area of rail contact. Such a condition is not considered dangerous and the wheels are not always promptly removed. Hence the shells or flakes spread over a greater length of tread and the cracks penetrate so deeply that when the tire is turned up a large amount of metal is wasted to remove all traces of shelliness.

A shelly tread may be produced by inherent defects in the steel such as pipes, gas cavities, entrapped slag and segregation, but more commonly service conditions produce the result. Tires made from long ingots seldom develop this defect, as the imperfect portion of the ingot is removed. The shelly tire due to inherent defects differs from the shelly tire as developed by service in the fact that the inherent defect usually manifests itself as a single spot from which a large shallow piece has come out, while the service shelling may be several spots where pieces have broken out leaving distinctly granular fractures.

The service conditions producing shelly tires are usually brake burns, eccentricity of the wheel, unequal wheels on the same axle. These conditions are intensified by speed and load. The brake burn is probably the chief cause of the trouble. When a brake retards a wheel so that the latter slips slightly on the rail it produces several small hard slip spots or brake burns on the tread at the rail contact, and considerable heat is evolved at the same time. These hard spots are usually covered with irregular heat cracks, which under the pounding of the wheel on rail and the influence of the various stresses to which the tire is subjected, tend to penetrate into the tire, and this causes the steel to break up into shells or flakes.

Many of these spots are worn out by the friction between rail and wheel and by brake shoe action, before the shelly condition is produced. These wheels, however, tend to become eccentric, and may eventually develop deep shelling.

In mountain divisions of railways the shelly form of defect is less frequent than on easy grade divisions, because on steep grades, long and continuous brake application grinds off the hard spot faster than the rate of crack penetration, while on easier divisions with less frequent brake shoe action the heat cracks on the spots penetrate the tire faster than the tire is worn down.

Driving tires are practically free from shelly spots. Brake burns and slip spots do appear on these tires, but the rate of crack penetration is slow on account of the greater diameter of the wheel and the consequent flatness of the arc, and their removal by brake shoe action is almost certain. The liability to shell is greater in tender wheels under large capacity tenders in through passenger service than in any other wheels. The conditions of service for these wheels is most severe owing to the constantly shifting and varying load carried. The varying load affects the intensity of brake shoe pressure and increases the liability to brake burn spots. Tender springs are designed for full load, but carry a light load much of the time. This causes the tender to ride rough and to pound. All these conditions are aggravated in the winter. Tender wheels are often allowed to run longer than those under coaches. Records of wheel lathes often show an average of about twice as much metal turned off tender wheels as that turned from coach wheels.

Trailer wheels under locomotives rank next to tender wheels in the tendency to develop shelliness. Coach and engine truck wheels come next in order. Most of the shelly coach wheels have been under heavy cars in through passenger service. The majority of cases have been distinctly traceable to brake burn spots. Thus it appears from the remarks of Mr. Norris that steel tired tender wheels under large capacity tanks in through passenger service show the greatest tendency to develop shelled spots, trailer wheels come next, coach and engine truck wheels next and driving tires last.

The Seismograph.

One of the New York daily papers which has a regular railroad column recently printed a paragraph in which it was stated that "Steam beats Electricity." The beating referred to was with reference to speed, and a steam locomotive on the Pennsylvania was said to have distanced its electric competitor by making very nearly 100 miles an hour.

In our December, 1907, issue, page 567, we pointed out that the trials being conducted at Clayton, N. J., on that road were for the purpose of determining the effect that steam and electric locomotives have on curved track, and that the idea of having a race between steam and electric locomotives was never entertained for a moment, much less attempted. More or less sensational paragraphs containing the idea of a speed contest have been printed in the daily papers. In these reports both truth and accuracy have been disregarded.

Another astonishing piece of daily press railway "news" is that in the track tests on the Pennsylvania at Clayton a seismograph was used for the first time on a locomotive. As a matter of fact seismographs have been used from time to time on locomotives, beginning many years ago, and there is nothing novel or particularly wonderful about the proceeding.

A seismograph is briefly and in general terms an earthquake recording apparatus. When one speaks of an earthquake machine, some people are inclined to stand aghast. The instrument re-

ferred to, however, is merely designed to graphically record vibrations, and it is principally used in meteorological stations for the purpose of automatically recording the vibrations of the earth which are taking place more or less distinctly all the time. The machine has plenty of work to do even when there is no violent disturbance of the earth. The tracing given by a seismograph somewhat resembles that given by the tracing pen in a dynamometer car. The word, it is true, is derived from the Greek *seismos*, an earthquake, and the termination is the same as that in the word telegraph, and means writing.

The seismograph has before now been used in locomotive practice to give a tracing of the vibrations of a locomotive running at various speeds, and such information is of use in testing the accuracy of the counterbalancing of the driving wheels. In the present instance it is probably used for the purpose of ascertaining the difference in the vibration of a steam and of an electric locomotive when rounding a curve due to what is sometimes called the "nosing" of the engine.

The seismograph thus applied will show how each style of engine goes round a curve and will record the more or less minute lateral oscillations which take place at various speeds. The results of the Pennsylvania track tests will no doubt reveal many useful and important facts, but there will not be anything concerning steam and electric locomotives racing, and the seismograph will do its scientific work now as it has done it before, and without having anything sensational about it.

Spark Arresters.

The chances of damage by fire from locomotive sparks are so great that much pains have been taken by many eminent locomotive constructors to avoid the liability to damage of property from this source. It is conceded to be a physical impossibility to entirely avoid this danger, inasmuch as the production of sparks is one of the inevitable circumstances arising from the burning of any kind of wood or coal under any condition. With a forced draft such as is caused by the intermittent blasts from locomotive exhaust pipes, the spark producing causes are very great, and it will be noted that the greater the power that is used in propelling the locomotive, the greater the production of sparks.

This is readily accounted for from the fact that with a long valve travel at a full pressure the steam is at a higher degree of pressure when released than when the valve opening is of less duration, and a limited quantity is admitted to the cylinder. Hence sparks are plentiful in starting heavy trains and in hill climbing and other severe work. The character of the fuel also is of much importance in spark producing, soft coal being much more prolific in that regard than the harder kinds of coal.

Extensive experiments have demonstrated the fact that every kind of spark arresting device has some deterring effect on the fuel combustion and consequently on the generation of steam. The problem therefore has been one involving the highest degree of spark arresting quality while looking towards the least retarding effect on combustion. The deflector sheet lends itself readily to the initial stoppage of much of the flying particles of unconsumed fuel that are carried through the flues by the sudden rush of air caused by the vacuum produced by each successive blast from the exhaust pipe. The creation of a cavity or receptacle in the saddle or under the extended front of the smoke box was a step in the right direction, as the constantly accumulating ashes and cinders materially affected the steaming of the locomotive.

The use of wire netting in the early locomotives began in the smokestack and gradually came lower and lower until it took the general form of a screen extending across the smoke box near the centre and below the exhaust nozzle, which arrangement does away very largely with the tendency to rust. A semi-circular piece of netting in front completes the device. This has been greatly improved upon by constructing the netting in the form of a hopper, being attached to the deflector sheet by pieces of angle iron and held on the sides and front by angle iron strips. The extended sloping sides of the hopper-shaped device not only presents a more ready angle of entrance for the escaping smoke and gases, but it also provides a much larger space for the same purpose. It is an important feature in the construction of smokebox screens that the amount of opening in the netting should at least equal the area of the smokestack. It is generally more. The opening in wire netting or perforated plates being generally more than half of the entire surface of the material, a comparison between the smokestack area and the area of the netting can readily be made.

The exact fitting of the netting or perforated metal around the steam pipes and exhaust pipe is of the utmost importance, as the great heat to which the material is subjected, with intermittent cooling, has the effect of warping and bulging the material in a very short time, with the general result that openings and fractures are constantly occurring. It may be stated that in general railroad practice the smokebox should be carefully examined every day. The finest materials of which the spark arrester can be constructed soon lose their consistency and rapidly crystalize and decay. Patchwork, like mending an old garment with new cloth, has the effect of creating new rents, and there is perhaps no part of the modern locomotive that is more liable to serious fracture or distortion than the spark arrester. It is to the credit of the leading railroads that, generally speaking, the smokeboxes of the locomotives are kept in good condition, but it is also true that many of them are not as carefully watched in this particular as they should be.

Referring again to the liability to accident by sparks, it may be added that while the devices in use have reduced the danger to a low point, atmospheric and climatic conditions have much to do with the matter. In continued warm, dry weather, and with moderately strong wind, sparks small enough to pass through the spark arrester will fly more than a hundred yards from the track and still retain some heat which might kindle very inflammable substances. The heaviest sparks do not pass over thirty yards from the track, and this may safely be called the danger line, beyond which it is doubtful if any disaster directly traceable to sparks ever occurred.

Shock Absorbers.

The words "shock absorber" have come into pretty general use, especially since our automobile friends looked around them for a device which would act as an auxiliary to a spring. The function of a shock absorber is to take up a sudden impact without developing any very great amount of recoil. Neglecting internal friction, a spring gives out about as much as is put into it, while a shock absorber is supposed to act somewhat quicker than a spring, and to turn some of the force of a sudden blow into work, and so "absorb" the shock, and in the process of giving out again, which in a spring we call the recoil, more work is done.

Friction draw gear on a car is a shock absorber because it acts quickly, and makes the force of the blow do work, and recoils comparatively slowly. In a certain sense the springiness at the end of a tapered fishing rod is a shock absorber, but it resembles a spring in the matter of recoil. Another form of shock absorber is the spring, or more often the barrel-shaped mass of solid rubber on top of the cylindrical casting of the Bissell truck on a consolidation engine. The shocks

transmitted through the equalizer to the king pin of the truck are "absorbed" by the rubber. The work done is by the internal displacement of the particles of the rubber when the mass is slightly flattened.

Sometimes there is a so-called shock absorber used at the end of a chain or lifting rod in a shop crane or hoist which is intended to reduce the effect of jerks when lifting material in and out of a machine. This may be made in the form of a stirrup with a flat plate held in place by four nuts, two outside and two inside, at the ends of the stirrup or staple. In the centre of the flat plate a hole is drilled through which a spindle passes which is held to another flat plate by a nut on the outside. The second flat plate slides on the legs of the staple. A spiral spring surrounds the spindle and lies between the flat plates, and the spindle has an eye on its outer end to do the lifting. The second flat plate slides up and down, according to the extension or compression of the spring between the flat plates. This is a useful device, but it is a shock absorber in the sense that it prevents the material being jerked when the slack of the lifting chain or bar of the shop hoist is taken up.

Trials of Master Mechanics.

At a recent meeting of the New England Railroad Club a paper on "The Trials of a Master Mechanic" was presented by Mr. R. H. Rogers, and was discussed at considerable length by the members. The paper was full of reminiscences which showed that the writer had a keen insight into human nature, and had learned the knack of handling men. The following extract is a good illustration of a method used by Mr. Rogers in keeping men satisfied:

"On a Middle West railroad several years ago, where I happened to be roundhouse foreman, I was pursued for a time by the valve-setting hoodoo. As we all know, there is no mystery in this operation, but it is hard to make the rank and file think so. The engineers were grounded in the belief that practically all of the engines were out of square and much grief resulted. We went carefully over all of the through passenger engines, and unquestionably the adjustment of the valves was correct. That is, the cut- off did not show any greater variation than one-quarter of an inch between the four points, and the lead was what the home office told us to make it. Finally the trouble ceased, with the exception of one engine, which made a round trip every day on the most important passenger run. This engineer voiced the usual extravagant statements, 'would not run down a well,' etc., etc., and needless to add, lost time every day. Things were fast assuming such shape that we began looking for envelopes marked 'personal,' but the day was finally saved.

"This man was a fairly good engineer, but I analyzed his failing in that he had a wholesale respect for anything which he did not understand. I knew that the last desperate resource was to play on this weakness, and after satisfying myself that everything underneath was all right, I ornamented the steam chest and half the smoke arch as well, with all the old algebraic formulas I could resurrect from the misty school days. It merely remained to be deep in the study of one of these problems when he came around to see how the valve setting was progressing, and to hear him remark, 'I'll bet she is all right now,' to feel the success of the trip assured. Sure enough, he began making up twenty-five minutes on the run where he couldn't make time before, and all this without a nut being slacked off on the engine; and he was loud in his praise of the fellow who set the valves 'right'—in other words, 'by mathematics.' I merely cite this case as an illustration of the manner in which a hard trial may be surmounted. This trick, pardonable under the conditions, may not have worked on more than one engineer out of one hundred, but with one it would, and he was the man."

In the matter of providing material for the needs of locomotive equipment, Mr. Rogers has had the usual experience, which he presents very cleverly. In recounting his experiences he states: "There is certainly no greater trial for any man's patience than to have a bunch of orders returned every day, marked 'not in stock.' Always it is something of which you are in the greatest need. In particular, the locomotive equipment is a serious problem. I venture to say that with possibly two or three exceptions this matter of keeping supplies on locomotives is nothing more than a bluff or a farce.

"This situation is extremely embarrassing to a master mechanic, and too often a temporary remedy is sought in robbing one engine for another; and I may as well say now, that this thing once started, never stops. I have known an engine to be laid in about two weeks waiting for some minor casting, and to be so stripped in that time, owing to storeroom shortage, that scarcely more than the boiler and wheels remained.

"The extremes to which a man may be driven would scarcely be credited. I worked for one road some years ago which possessed more than its share of able-bodied requisition slashers. It was not out of the accepted order of affairs to see an engine go out on an important passenger run with a lantern stuck up in the headlight case in lieu of an interior. When an engine would come on the ash pit a gang of men would be waiting to remove the grease-cup plugs, coupler knuckles, headlight reflector, and occasionally the air hose, with which to get something else into service. Even the fire hooks and shovels, especially the latter, ran first in, first out, and when they began chain-ganging the tanks and reverse lever latches, I left for a place where the pay was less but things were not quite so strenuous. This was the only instance in my career when I voluntarily threw up the sponge. This same road, by the way, also ran out of nuts. They had plenty, of course, two and one-half and three inches, which would have filled the bill all right in some marine engine works, but none of the common sizes, seven-eighths or inch. In consequence a machinist at thirty cents an hour would spend half a day rooting in the scrap pile, and the other half tapping the few nuts he was lucky enough to find. The entire situation was distressing in the extreme."

On the subject of the young master mechanic keeping his job, Mr. Rogers gives some general principles which are extremely interesting and instructive. He said:

"If a man can successfully cope with the varying conditions during twelve months, he may be considered to have passed from the experimental stage. There should not indeed be a condition with which he could not deal. I rather think that the requisite for such peace of mind as may be permitted a master mechanic is the knowledge that he is a good mechanic. This must be strong enough to convince himself, and he must also have quite an insight into human nature. If through his experience he has no reason to doubt these attributes, and employs them to the best of his ability, the job is safe. The policy of railroads at the present time is to avoid radical changes. On many, indeed, the organization has become established on a permanent basis. If a man puts in his best licks the first year, makes a material reduction in the pay-roll, and maintains a reasonably better showing than his predecessor in the matter of engine failures and freedom from labor troubles, he has established a most convenient reference table for guidance in the future."

Different Brands of Train Dispatchers.

A railroad official who seldom receives fair credit for efficiency is the good train dispatcher. An efficient engineer and a skillful fireman generally receive credit for their superiority to careless and inefficient enginemen; but a train dispatcher seldom receives credit for exerting influence on the cost of train operating, although he has opportunity to save or waste fuel far beyond those of a single engineman.

The efficient train dispatcher is familiar with the physical condition of his division, with its grades and curves. He keeps himself informed on the condition of the various engines and of the peculiarities of the crews handling them. This enables him to tell with exactness what meeting privileges he is safe to accord the various trains. The extension of ten minutes' time to reach a meeting point may mean saving of an hour's delay to a train and of the waste of fuel represented by that time spent idly on a siding.

We might give many reminiscences of the good train dispatcher and his influence upon the prompt movement of trains. We might also contrast his results with those effected by a dull, indifferent successor whose supreme thought was quitting time. But we refrain. All railroad men of observing habits know the difference between the smart and the plug dispatcher.

Book Notices.

The Scottish and American Poems of James Kennedy. Fourth thousand. One volume, 224 pages, ornamental cloth. Price $1.

A new edition of the writings in verse of James Kennedy will not only be warmly welcomed by all the lovers of Scottish dialect compositions, in which tongue he has long been looked upon as the foremost living poetical exponent, but also by a wider circle of readers to whom his more recent productions in English are appealing. Of the chief characteristics of Mr. Kennedy's work in verse it may be justly said that he excels in that species of humor which is peculiarly Scottish. Nearly half the volume is taken up in a series of character sketches which are condensed dramatic comedies told in varied and flexible measure that stamp the author as a most accomplished poet, possessing the rare faculty of catching and fixing the salient features of character and giving perfect literary expression to a wealth and variety of incident at once quaint and irresistible.

The compositions in English excel in the realm of descriptive poetry. Nature in her varied moods, especially in the glow and glory of summer, are finely described, while the heroic element is ably sustained in "The Highlanders in Tennessee," a narrative poem which has been justly praised as among the best compositions in verse in connection with the American Civil War.

In relation to Mr. Kennedy's writings in verse it is remarkable that while his life has been spent almost entirely among railroad men as machinist, shop foreman, mechanical instructor and latterly associate editor of Railway and Locomotive Engineering, he has never mixed poetry and engineering. His subjects are apart from his daily work and the Muse seems to have been the solace of his leisure hours, just as some skilled artisan may also be a skilled musician. This duality of character is not unusual. Indeed it seems to be the rule instead of the exception among the poets who have resided in New York, as is evidenced in the lives of Bryant and Halleck and others. In Mr. Kennedy's instance there is a double duality of character, as much of his verse has the patriotic pride that lingers lovingly over the tender and glorious memories of Scotland, while superadded to this pardonable pride the love of America and her free institutions glows in many of his polished lines. The book may be obtained on application to this office.—C. L. W.

Proceedings of the Fourteenth Annual Convention of the Air Brake Men's Association. 320 pages. Published by the Association. Boston, Mass. Price, leather, $1. Paper 75c.

The annual reports of the Air Brake Men's Association have come to be looked upon as the high water mark of air brake literature, and all who are closely interested in the devices used in air brake mechanism should secure a copy of the published proceedings of the association. Mr. F. M. Nellis, the able secretary, has become by long experience not only a thorough expert in air brake matters but he possesses the higher faculty of imparting information to others. The lack of space prevents us from giving in detail even a list of the subjects on which special papers were presented and discussed. Suffice it to say that the questions were all of the utmost importance and are discussed with a degree of fullness that leaves nothing to be desired.

The book is of the usual master mechanic's standard size, similar to Railroad club proceedings, elegantly bound in flexible morocco. The illustrations show a marked improvement over previous years, while the typography is worthy of the reputation long enjoyed by Boston publishers and printers.

The Report of the Fifteenth Annual Convention of the International Railroad Master Blacksmiths' Association, held at Montreal in August last, has just been published in a handsome volume of 244 pages. The volume is one of the best that has been published by the association and the number of subjects discussed and the importance of many of them render the book of especial value to all who are interested in the blacksmith's trade. A portrait of the president, Mr. J. S. Sullivan, is given as a frontispiece, and a number of photographs and drawings accompany some of the papers.

Nothing except the mint can make money without advertising.—*Rt. Hon. W. E. Gladstone.*

Among the Railroad Men.

By James Kennedy.

At the Burnside Shops.

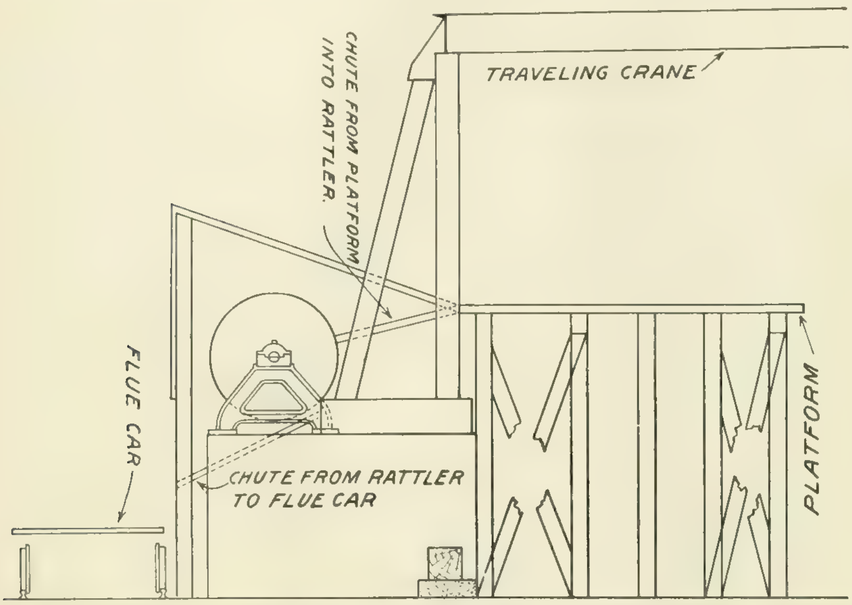
The Chicago offices of the Illinois Central Railroad are finely located with an unobstructed view of Lake Michigan on one side and one of the numerous public parks on another side. The great central artery of travel between Chicago and New Orleans starts here, embracing nearly 5,000 miles of railway. A few miles along the lake shore and we are at the Burnside shops, the chief mechanical center of the vast system. Mr. W. Renshaw, Superintendent of Machinery, is the presiding genius, and his multiplex duties are cleverly simplified by Mr. T. F. Barton, M. M., and Mr. G. M. Crownover, Asst. M. M. The shops are among the largest in America. Their construction began in 1893 and have been added to from time to time, until the clustered squares of buildings resemble a miniature city. Fully 3,000 men are at work here, and the most advanced methods and the best mechanical appliances are in operation. The store rooms for the entire system are also located here and they occupy a building as large as a city block, where between two and three hundred men are occupied loading and unloading the necessary commodities of the great railway.

In the shops there are evidences everywhere of the perfection of detail in the classification of work. Every part of the locomotives under reconstruction or repair are grouped in divisions and subdivisions with a military precision that is manifestly the outgrowth of a wide experience. In the matter of constructive material there is an apparent tendency to the wider use of brass or bronze than is commonly seen in railroad shops of the present day. Cast steel driving boxes lined with bronze, brass wedges, brass eccentric straps, together with burnished brass hand rails, gave a brilliance to the separated parts of the superb locomotives that reminded one of the vanished glories of the golden splendors of the locomotives of Richard Norris & Sons of fifty years ago. There is a wide difference, however, between Norris' museum curiosities and the magnificent engines of the Illinois Central.

Some of the shop methods are worthy of imitation. Lathes were moved from place to place by the swift traveling cranes to suit the needs of the moment. A complete set of binder bolts were fitted "while you wait," and the crane came along and lathe and man were gone to where another dozen of holes were reamed and ready. Chalking the frames was explained to

be the best method for detecting cracks. Flues were cut out with a rapidity that was altogether marvelous. An air contrivance was inserted in the flue and one revolution did the job. They were cut nearly as fast as one could count. Air brake and other valves were being ground by machinery, an eccentric contrivance lifting them out with the rhythmic cadence of dancing dolls. Michael Angelo was said to have chipped marble with such rapidity, when the sculptor's passion was upon him, that it took two Italian laborers working overtime to wheel away the chips. At the Burnside shops there are several wheel lathes where the rough rims are turned off with such amazing velocity that the red, white and blue spirals that are spun like hempen ropes from the hard steel tires, keep a swarthy laborer busy gathering up the endless chains of turnings. The finished rims are smooth as the work of a Norton grinder, and the perfected wheels follow each other out of the workmen's hands like a flock of sheep passing out of the hands of the shepherds at shearing time.

The Flue Rattler has several novel features that facilitate the handling of the flues. As will be seen in the accompanying drawing, a traveling crane places the flues on an elevated platform where an inclined plane leads them into the rattler. A movable trap door forming part of the inclined plane is readily opened or closed, and another inclined plane forms a chute beneath the rattler leading the flues to a car beneath. The flues are literally never handled at all except in the welding process, which is accomplished with little physical effort at the rate of about 300 per day for each man.



QUICK METHOD OF HANDLING TUBES AT THE BURNSIDE SHOPS, ILLINOIS CENTRAL RAILROAD.

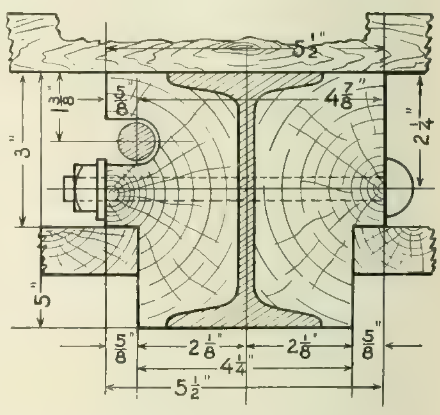
In the car department, Mr. J. M. Borrowman, the general foreman, kept pace with the master mechanics in the locomotive department. The magnitude of the car works can readily be imagined when it is stated that in addition to the general repair work of the entire system a special order for 400 new box cars was being filled at the rate of ten cars per day, and arrangements are already on foot for the construction of 800 more cars of the same pattern. The cars possess several new features in construction, the improved stability of the design of the I-beam end posts being, as is shown in our illustration, particularly marked. The underframes and bracing have also several marked improvements which, while they do not increase the weight of the car, increase the carrying capacity considerably. In the passenger car department the feature of using a number of doors in the sides of the cars seems to be coming more largely into vogue. This British feature of passenger cars has many advantages, and the Illinois Central seems to be the first road so far that is seriously adopting the sensible arrangement. Its adoption by the city railroads of New York and elsewhere would probably be a great benefit to thousands of daily travelers.

It was gratifying to note the very superior class of men occupying the places of responsibility about the extensive works. Accomplished men were there from all over America and Europe. Studious, self-reliant men of wide experience seem to gravitate to Burnside, and their impress can be seen all over the great mechanical center. Mr. W. O. Moody, although one of the youngest in the coterie, is generally acknowledged among them as the prince of mechanical engineers. He does not dwell, like a cloistered monk, in some distant cell. He is everywhere, and always within easy reach of the highest and the humblest.

Feast to Famine in Oil Supply.

There is every reason for believing that much fuel is wasted and cylinders and valves subjected to destructive wear through the rigid restrictions in the use of oil put upon engineers. That restrictions were necessary is doubtless true, but the injunctions to be economical with lubricants need to be imposed more judiciously than they are in many cases. Conditions are very different now from what they were in the old days when an engineer was at liberty to use as much oil as he saw fit.

Many men are not capable of controlling themselves or the use of material when left to themselves without restriction. It used to be common on every division to find engineers who never failed to oil round every time the train was stopped. Such men never thought a cup or box had enough oil until it was running over. The track was literally soaked with oil and grease wherever such engines stopped for five minutes. The engineer would make himself believe that the lavish use of oil kept the engine in good order and helped to reduce coal consumption, but it frequently had the opposite effect. So much lubricant was constantly passing through the nozzles that they would become gummed in four or five hundred miles running. Cleaning would not be done till choking of the exhaust was too evident to be overlooked; meanwhile the sharp exhaust had been for many miles tearing the fire and wasting coal.


DESIGN OF ILLINOIS CENTRAL BOX CAR END POST.

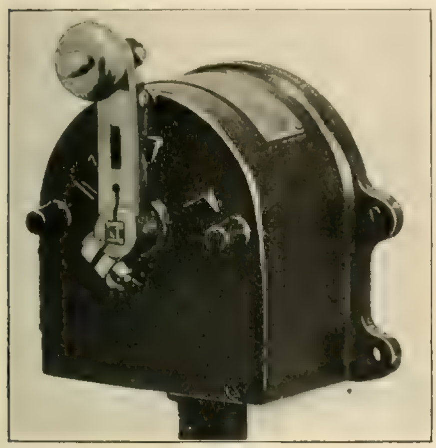
Remonstrances would be made by roundhouse foremen and master mechanics, but nothing would cure the grease waste but a strictly enforced reduction of the supply.

Correspondence School

The Automatic Controller.

By W. B. Kouwenhoven.

The controller described in the December issue was of the hand or manually operated type, that is, the motorman governed the rate of application of the electric power to the motors. He could advance the controller handle to the various notches as quickly or as slowly as he desired, provided the



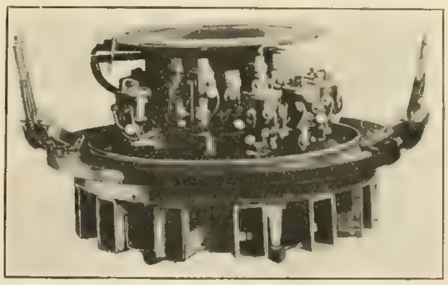
THE AUTOMATIC CONTROL.

circuit breaker did not open or the fuse blow out. The automatic type of controller, however, supplies the power to the motors in successive steps in the same manner as the hand control does, but in the automatic type the time allowed for each step or the rate of application of power is governed, not by the motorman, but by a device known as the limit switch. This device gives a uniform rate of acceleration and prevents the application of power in excess of a predetermined rate.

In order to produce a uniform rate of increase in speed, or in other words, to secure a uniform rate of acceleration, the electric power must be applied gradually step by step to the motors. These steps must be taken at such regular intervals of time as will give the best rate of acceleration. By this we mean a rate of acceleration which will be economical of both current and equipment and at the same time meet the needs of the train schedule and afford comfort to the passengers. No two motormen can notch up a controller at the same rate, and it is practically impossible for the same man to do it twice at the same rate. The limit switch is intended to do what the motormen cannot do.

The limit switch consists of a solenoid such as was described in our January, 1907, issue. It is placed in series with one of the motors, so that the current must pass through the limit switch before it reaches the motor. When the motorman places the controller handle on the first notch, the contactors make the connections to feed the current to the motors. Besides passing through the resistances or rheostats, and the two motors, the current must also pass through the limit switch. Now, if he moves the handle to the second notch too quickly, the current fed to the motors will increase too rapidly. When this current exceeds a predetermined amount set by the limit switch, the solenoid attracts its armature, thus opening a pair of contacts in the train line circuit, and holds these open so that no additional contactors can close (those contactors already closed, remaining closed) until the current falls below the predetermined limit and the armature drops, closing the circuit.

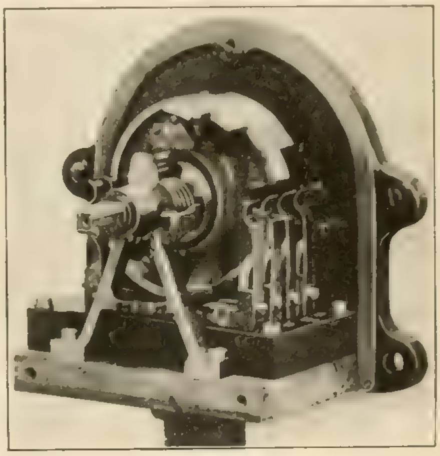
If in the manually operated type of control the motorman should throw his controller handle to the multiple running position, the circuit breaker would open or the fuse blow out. If neither of these protective devices worked, the sudden application of the full power would damage the motors and the train would not start, as was stated in



UNIT SWITCH GROUP.

our article on the electric controller. In automatic types it is customary to throw the controller handle to the full multiple position, and allow the limit switch to govern the rate at which the contactors shall apply the power. In many of the automatic types of controllers the master controller handle, which is operated by the motorman, has only three notches or positions, while there are at least eight or ten steps in the application of the power to the motors.

The principal parts of the Westinghouse system of automatic control are the master controller, the limit switch and the switch group. The switch group corresponds to the group of contactors of the Type M General Electric Control described in our last issue. In place of the thirteen contactors there are thirteen switches called unit switches. These unit switches are



MECHANISM OF CONTROLLER.

opened and closed by compressed air, and not by solenoids as were the contactors. The valves for controlling the compressed air are operated by small electro-magnets.

There is no exact counterpart of the automatic system of control in the steam locomotive. But suppose a locomotive is built with two throttle valves. The first, or throttle in the cab, having only three notches, the switching notch, the half speed notch, and the full speed notch. The second throttle located at some convenient place in the steam pipe beyond the first throttle, and controlled by a centrifugal governor in such a manner that as the speed increased, the lift of this second throttle would increase correspondingly. When the governor was at rest the second throttle would be open only a small amount. Now suppose the engineer open wide the first throttle. The second throttle would only admit a small amount of steam to the cylinders, and the train would start slowly ahead. If it were not for this second throttle there would be a great rush of steam to the cylinders and the drivers would spin around on the rails, and the train would not start.

As the speed increased, the second

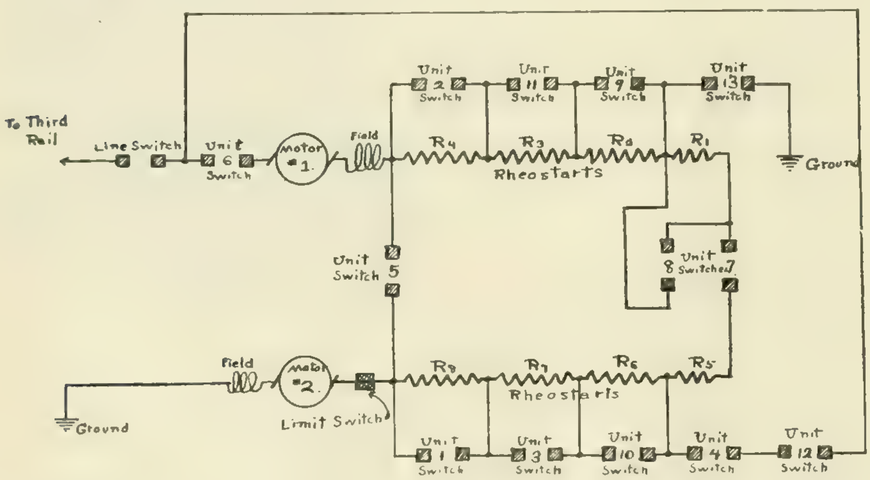
throttle would be opened more and more by the governor and the supply of steam to the cylinder would be gradually increased, in much the same manner as the limit switch allows the unit switches to supply more and more current to the motors. There would be no slipping of the drivers and the rate of acceleration would be only as fast as that permitted by the governor. The supposed governor of this locomotive corresponds to the limit switch of the motor car; the second throttle in the steam pipe corresponds to the group of unit switches; and the first throttle, the one in the engineer's cab, corresponds to the controller handle in the motorman's cab.

If the engineer wished to use the engine for switching he would open his throttle only to the switching notch. The governor would open the second throttle up to the point corresponding to the first, or engineer's throttle, and no further, because no more steam could get past the first throttle than the amount allowed by the engineer.

If he wanted to run his engine slowly he would open his throttle to the half speed notch. The governor would bring the engine up to speed gradually by opening the second throttle a little at a time. When the second throttle had been opened half way, the governor could open it no further because it could not obtain steam enough to drive the engine any faster. So in the motor car the unit switches are never ahead of the position of the controller handle, because in order to continue to operate, they need power supplied by that handle through the fingers and contact strips on the controller drum.

Turning our attention now to the electric equipment, the automatic master controller is placed in the motorman's cab and has only one handle with six positions, three for ahead and three for the reverse. The three positions are the switching notch, the series running notch, and the multiple running notch. The single handle is the reverse lever and throttle lever combined. By moving the handle to the right the train moves ahead, to the left the train moves in the opposite direction. The controller is, of course, horizontal. On the drum are mounted contacts upon which the fingers rub in much the same manner as in the Type M controller, the principal difference being that there are fewer contact strips and fingers in the automatic type than in the Type M.

The limit switch consists, as we have said, of a small solenoid in series with motor No. 2. When the current rises above a predetermined value the armature of the solenoid is raised against gravity, thus lifting a disc off two contacts in the train line circuit. The unit switches that are closed remain closed, but no others can close until the current falls below the limit and allows the disc to fall back on the contacts.



ARRANGEMENT OF WIRES, RHEOSTATS, MOTORS, WITH AUTOMATIC CONTROL.

The unit switches are thirteen switches or contactors that are grouped radially around a powerful magnet. This magnet serves to extinguish the arcs that are formed by the opening of the unit switches. Just above each switch is an air cylinder which operates the switch. On the outer edge of each cylinder is mounted a valve which is operated by an electro-magnet. These valves are called magnet valves and control the admission of compressed air to each of the cylinders and also its exhaust to the atmosphere. The compressed air is supplied from the air brake system. The piston in the cylinder on its down stroke closes its unit switch against a powerful spring. When the magnet valve opens the exhaust to the atmosphere, the air escapes and the spring raises the piston, thus opening the switch. These magnet valves are operated from a storage battery at a potential of 14 volts. Two storage battery sets are carried on each motor car, one being in use and the other in reserve. The switch group is inclosed in a turret-shaped piece of sheet iron, and this turret-shaped cover has given this system of control the name of "the turret control."

When the motorman moves his controller handle to the first position or the switching notch on the right hand side of the drum, the fingers make connections with the copper strips on the drum and the line switch, the line relay, which is a safety device, and the reverser. The line switch completes the connections between the contact shoe and the car. The reverser makes the connections for the ahead position and at the same time closes a device known as an interlock.

In the manual Type M control described in our December paper, the motorman moves his controller handle from notch to notch, there being ten notches, or steps, but in this Westinghouse automatic type of which we are now speaking there are but three notches on the drum for each direction of motion, but there are ten steps in the application of the power to the motors. The interlocks serve to make the connections automatically and correctly for these ten steps.

On all of the unit switch magnet valves except Nos. 6 and 7, there are two coils, one for picking up the valve, called "the pick-up coil," the other for holding up the valve, called "the hold-up coil." The excitation of the pick-up coils is made by the various interlocks through the contacts of the limit switch. When a pick-up coil has actuated a valve and admitted air to the cylinder closing the unit switch, it also completes the circuit for the hold-up coil, and the unit switch will remain closed until the circuit of the hold-up coil is opened.

As soon as the interlock on the reverser closes it completes the circuits through the pick-up coils of unit switches Nos. 6 and 7, and they admit compressed air to the cylinders and thus close the switches. This puts all the resistance in series with the motors, and is what corresponds to the first series position as described in our last issue.

On moving the controller handle to the second notch, or series running position, the fingers and contact strips of the controller drum make connections so as to close unit switch No. 8. Switch No. 8, on closing, closes its interlock and cuts out one of the resistances and there is an increase of current supplied to the motors as well as of power. If this current exceeds that for which the limit switch is set, it raises its armature, preventing the interlock of No. 8 from making the connections through the pick-up coils of unit switches Nos.

9 and 10. As the speed increases and the current falls below the limit for which the limit switch is set, its armature drops, thus closing the circuit through the pick-up coils of Nos. 9 and 10, and these are held closed by their hold-up coils.

As they close, their interlocks also close, and they cut out more resistance, making the third step in the application of power to the motors. The increased current again causes the limit switch to attract its armature and prevent the closure of unit switches Nos. 11 and 3. The speed continues to increase, and the current again falls, allowing the armature of the limit switch to drop and unit switches Nos. 11 and 3 close, cutting out still more resistance, and making the fourth step in the application of power. After the speed has increased sufficiently, Nos. 11 and 3 in turn close switches Nos. 1 and 2. This is the fifth step and is the full series running position. No resistances are now in series with the motors. Therefore no power is wasted, and this is the first economical point on the controller drum, and it has been reached automatically.

Now if the motorman turns the handle to the third position or multiple running position, the contact fingers of the controller drum make the connection and close unit switch No. 5. In so doing, the interlock of No. 5 opens the circuits of the hold-up coils of switches Nos. 7, 8, 9, 10, 11, 3, 1 and 2. As unit switch No. 7 opens, its interlock closes the circuits for the pick-up coils of switches Nos. 4, 12 and 13. When the interlock of No. 4 closes it opens the circuit through the hold-up coil of unit switch No. 5, which opens.

The opening of unit switch No. 5 and the closing of unit switch No. 4 changes the motors from the series running position to the first multiple position without the current supply to the motors ceasing at any point.

In many control systems the circuits to the motors are opened in passing from the series position to the multiple, and even if this is for a very short period of time, an unpleasant jerk or jar is usually felt by the passengers. On the system of control here described there is no such interruption of current, and there is no appreciable change in the rate of acceleration. This passing from series to multiple without interrupting the current supply to the motors is known as bridging.

This is the seventh step in the application of power to the motors. When the interlock of No. 4 closes, it not only opens unit switch No. 5, but completes the connections through the pick-up coils of switches Nos. 9 and 10. The increase in current raises the armature of the limit switch, and Nos. 9 and 10 do not close until the current falls low enough to release the armature of the limit switch. Unit switch No. 5 is so connected that it will be opened by the interlock of No. 4 closing, no matter whether the limit switch acts or not.

The closing of unit switches Nos. 9 and 10 makes the eighth step in the application of the electric power to the motors. As the train gains speed, unit switches Nos. 11 and 3 and Nos. 1 and 2 are closed in turn. When Nos. 1 and 2 have closed, all of the resistance is cut out of the circuit. This is the multiple running position and is the tenth and last step in the application of power to the motors. This is the second economical point on the controller drum.

In the application of the electric power to the motors, the unit switches are never in advance of the position of the controller handle. That is, if the handle is thrown to the switching notch the unit switches can only make the connections for that one position. When the handle is thrown to the series running notch, the unit switch will proceed as described and make the proper connections in the four regular steps until all the resistance is cut out of the circuit and the motors are in full series. The unit switch will not proceed any further until the handle is thrown to the multiple running notch. When this is done the unit switch will proceed to put the motors in multiple and cut out the resistance in five steps until all of it is cut out and the motors are in full multiple.

If the controller handle is placed on the multiple running position at the start, the unit switches will automatically, and in the proper order, notch themselves up to that position without missing any of the ten steps, and at an even rate of acceleration which is governed by the action of the limit switch. If the motorman's hand should be removed from the handle of the controller it will immediately return to the off position, due to a spring in the controller drum, and thus will cut off the power supply to the motors.

As in the Type M control described in last month's issue, the wires which operate these unit switches or contactors are bunched into a train line which terminates in a jumper at each end of a car, like a brake hose connection. Any number of cars may be joined together by the use of train line couplers, and all of the motors in the train may be operated by any automatic master controller on the train. The limit switch in each motor car determines the rate of application of power to the motors of that particular car.

On any one system which uses this type of control, as, for example, the Brookly Rapid Transit system, the limit switches on all the cars are set to raise their armatures for the same current value. This current value is one that will satisfy the conditions laid down for producing the best rate of acceleration.

Elements of Physical Science.—IX.

HYDROSTATICS.

Hydrostatics is the science that treats of liquids at rest, and differs from hydraulics that treats of liquids in motion and the machines in which the motion is applied. The incompressibility of liquids was long considered as a fixed fact, but modern experiments have proved the reverse to be the case. It has been discovered that the water at the bottom of the ocean, at a depth of five miles, is one-fortieth heavier, volume for volume, than the water at the surface. Water submitted to a pressure of 10,000 lbs. to the sq. in. loses one-thirty-sixth of its bulk.

The general law of hydrostatics is that water at rest always finds its level. Advantage of this law is taken in supplying cities with water from elevated lakes or streams. The water may be conveyed through extensive depressions, but will rise again to the level from which it started. It is a remarkable fact that while the ancient Romans were familiar with the use of pipes in conveying water, they brought water to the cities through vast level aqueducts which were built at enormous expense. Possibly the difficulty in making strong iron pipes and keeping them tight at that time compelled the use of the great architectural works, some of which are still standing.

The spirit level, an instrument much used in all building operations, is an illustration of water finding its own level. If the air bubble in the instrument is in any other place than the center it shows that one end of the tube is higher than the other, and consequently that the surface on which it rests is not level.

LIQUID PRESSURE.

The transmission of pressure in liquids differs from that on solids by reason of the fact that pressure on the latter continues only in the line in which it is exerted, while in the former it is transmitted in every direction. There is an increase in the lateral pressure of liquids according to the depth, hence the walls of dams and breakwaters should increase in strength toward their bases. This law leads to very remarkable results. Incredible effects may be produced by a small body of liquid having considerable depth. A strong cask may be burst

with a few ounces of water in a long pipe inserted in the top of the cask. The cask being filled with water it will readily be rent asunder by simply pouring water into the tube. Many convulsions in the earth have been caused by this means, as a crevice in the earth's crust may be filled with rain water, and if the rent in the earth be sufficiently deep it may generate pressure so great that rocks may be rent in fragments.

Liquid pressure being thus in proportion to depth alone, a very small quantity of liquid will balance any larger quantity. This remarkable quality is called the hydrostatic paradox. The best illustrations in mechanism are in heavy presses where a small jet of water is forced into a larger cylindrical vessel where the power may be multiplied a thousand times, the exact ratio being as the square of the diameters of the feed pipe and the square of the diameter of the press cylinder. Truck and engine wheels are pressed into place on the axles by this means. There is no limit to the power of the hydrostatic press other than the strength of the materials of which the press is composed.

SPECIFIC GRAVITY.

The term specific gravity is used to express the weight of different substances. The standard employed is distilled water at 60 degrees. Distilled water is taken on account of its purity. The temperature is fixed because at a higher or lower degree of heat the density of the water would be affected. Fluids that do not mix when brought together, quickly arrange themselves in the order of their density, the heaviest finding their way to the bottom. The specific gravity of a body is its weight compared with that of a like bulk of water. The finding of the specific gravity of liquids is usually accomplished by the use of a glass vessel whose weight is known. Fill the vessel to a certain height and weigh it; substract the weight of the vessel, and note the weight of the water alone. Then fill the vessel to the same height with the liquid in question, weigh it again and subtract the weight of the vessel as before. Divide its weight by that of the water and the result will be the specific gravity of the liquid in question.

The specific gravity of solids is found by taking a certain bulk of the solid, ascertain its weight, and divide it by the weight of a like bulk of water. In the case of difficulty arising in obtaining a certain bulk of a solid body other methods may be resorted to, the simplest being first to ascertain if the solid sinks in water, then weigh it first in air, and then in water by means of a balance prepared for the purpose. Divide its weight in air by the weight it loses in water, and the quotient will be its specific gravity. From these calculations it will readily be seen that if we know the specific gravity of a body, we can easily find how much any given bulk of it weighs. A cubic foot of water weighs 1,000 ounces, or 62½ lbs.; the weight of a cubic foot of any given substance will therefore be equal to 62½ multiplied by its specific gravity.

The following table gives the specific gravity of a few of the most important substances, the specific gravity of water being estimated at 1:

Platinum	22.069
Gold	19.358
Lead	11.445
Copper	8.788
Tin	7.291
Iron, cast	7.207
Anthracite Coal	1.800
Soft Coal	1.250
Ice	.930
Alcohol	.792

Eminent Engineers.

III.—THE MARQUESS OF WORCESTER.

It is a remarkable fact that for nearly two thousand years little or no progress was made in the application of steam as a motive power. Mechanical curiosities were not wanting, but they resembled more the tricks of conjurers than the work of engineers. Strangely enough the few men who experimented with steam were all literary men of the highest rank in their day, and their descriptions of their machines have an air of romance about them that seems strangely foreign to mechanism. Cardan's whirling œlipile was scarcely any improvement on Hero's revolving globe, and De Cau's water raising apparatus was also of Hero's inventing, but both the sixteenth century worthies issued ponderous books describing their contrivances. Branca, a seventeenth century Italian engineer, made some advances in the use of steam on the mill wheel principle and although he communicated the motion to other wheels it served little or no purpose.

The Marquess of Worcester, an English nobleman who lived in the seventeenth century, made the first substantial advance in the use of steam. He was an adherent of the waning house of the Stewarts and was shamefully treated by the government of his day. His long imprisonment was beguiled by mechanical experiments and while his fortunes were sometimes of the direst he managed to employ the most skilled workmen in England, who continued a system of experiments with steam engines under the directions of the ingenious nobleman. His accomplished work is not great, but he had great visions of what steam could do. In his "Century of Inventions," published in London in 1663, he thus describes the steam engine that he was about to make: "An engine so contrived, that it will work forward or backward, upward or downward, circularly or corner-wise, to and fro, straight, upright, or downright, yet the pretended operation continueth and advanceth, none of the motions abovementioned hindering, much less stopping, the other; but unanimously and with harmony agreeing, they all augment and contribute strength unto the intended work and operation; and therefore I call this a semi-omnipotent engine, and do intend that a model thereof be buried with me." This is a better description of the steam engine of to-day than Rudyard Kipling gives us in "MacAndrew's Hymn."

There is much evidence showing that he had a variety of engines working chiefly in the raising of water. It is generally conceded that he was the first to use steam operating against a piston. His petitions to Parliament praying for an opportunity to demonstrate the efficiency of his engine were unheeded. His wife continued the petitions after the death of the inventor, but they also fell upon inattentive ears. The little that he was able to accomplish under the most depressing circumstances gives us a glimpse of what he might have done under happier conditions. He was a man of titanic visions. By the ignorant, besotted artistocracy to whom he appealed he was looked upon as a dreamer, which he was; but the dreams came true, although he never fully realized it in the physical sense. Henceforth the royal visions that came to him dimly fell upon other eyes that could see, and his prophetic words fell upon ears that could hear and understand.

The Steam Engine.

It is a matter of pride and satisfaction among manufacturers of steam engines to feel and to know that in spite of the phenomenal advance of electric, gasoline and gas engines the steam engine not only holds its own but continues to grow in favor. The reason is not far to seek. The steam engine in its perfected form has the element of reliability in a degree far beyond any other generating power. The element of economy is also of paramount importance. In this latter regard it may be noted that there are many steam engines running at the present time that have been in daily service for periods approaching forty years.

Questions Answered

BOILER SPECIFICATION.

(1) T. C. H., Johnstown, Pa., writes: Please say what you think would be a good chemical analysis of boiler steel to carry about 180 lbs. steam pressure, boiler to be 76 ins. at the smallest end?—A. There should be no difference in the quality of boiler steel depending on pressure. All steel plates used in boiler construction should be the best obtainable. The boiler plate specification recommended by the Master Mechanics' Association is a good guide to take in this matter. It is too long to reprint here. It was adopted in 1894 and was revised in June, 1904, and in its present form may be found on page 361 of the 1907 issue of the proceedings of the American Railway Master Mechanics' Association, which is the fortieth volume.

NAME AND ADDRESS ALWAYS.

(2) G. A., Appalachicola, Fla., writes: Please explain, etc., etc.—A. You have not observed the rule of signing your name, and your question is therefore not answered. This is not an arbitrary rule, but one founded on common sense. A correspondent's question may or may not be of general interest. If it is not, it is not answered in our columns, though we may wish to write to the person sending it in. If we do not have name and address we cannot do this. The name is never published in our question columns. In all communications to an editor name and address should be given as a guarantee of good faith.

RADIUS OF LINK.

(3) L. W., Portsmouth, Ohio, asks: How would you get the radius of a link of a consolidation engine? Are there different ways on different engines?—A. The usual way is to get the location of the center of the link. That varies for different classes of engine and for different designs, and is frequently determined by the position of other parts. When the center of the link has been decided on, the radius is generally struck from the center of the axle which carries the eccentrics and the distance between the center of the axle and the center of the link is generally the radius which determines the curvature of the link.

SOLUTION FOR CLEANING BRASS.

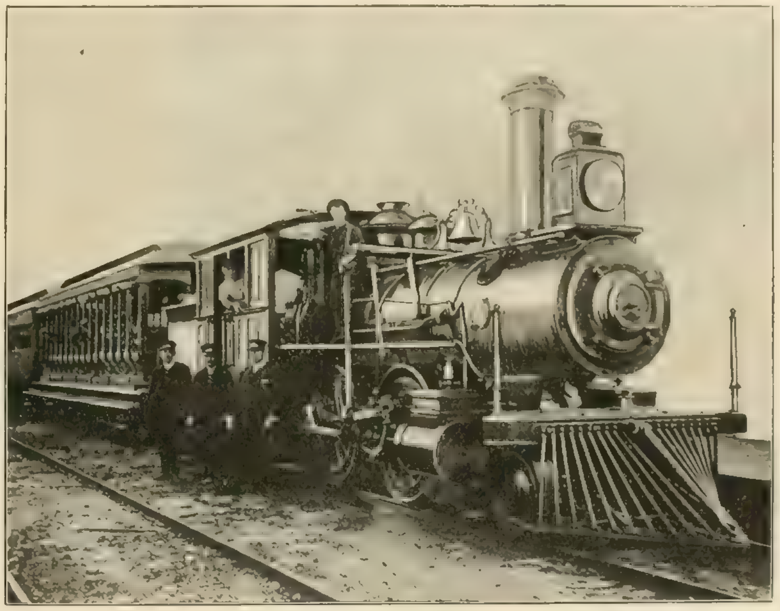
(4) J. D. C., Memphis, Tenn., writes: When I worked further north they had a solution for cleaning brass valves, oil cups and injectors. Could you give us a rule as to what the solution is composed of?—A. There are various compounds used in cleaning brass, a common one being 3 parts of sulphuric acid mixed with 2 parts of nitric acid. The acids are not weighed but measured. A handful of salt is added to each quart of the mixture. This mixture must be kept in a glazed earthenware or vitrified vessel or tub. The pieces should be dipped separately and removed at once and cleaned in cold water. A box of sawdust is useful in facilitating the drying of the pieces.

BY-PASS VALVE.

(5) C. G. T., Long Island, writes: What is the by-pass valve and how does it operate?—A. The by-pass valve is almost similar in construction to a safety valve, and is located in a cage that extends over the port leading from the steam pipe to the space between the heads of the piston valve. The by-pass valve is kept on its seat as long as the pressure from the steam chamber is greater than the pressure in the cylinder. If the pressure in the cylinder should, from any cause, become greater than in the steam chamber, the by-pass valve is lifted from its seat, thus relieving the cylinder and piston and cylinder heads from undue pressure. A slide valve does not require the use of a by pass valve because the slide valve will readily lift from its seat in the event of excessive pressure in the cylinder. A piston valve, however, having its bearing on every part of its circular suface, cannot so accommodate itself, and the by-pass valve relieves any excessive pressure.

OUTPUT OF SHOP.

(6) A. F., Johnstown, Pa., writes: I notice that in describing some shop methods you state that at some particular shops there is a larger turn out of lathe work than at others. Is there any rule in regard to the proper speed per minute for turning and planing steel and iron and brass?—A. No exact rule can be laid down to govern all cases. Much depends on the machines used, and also on the quality of the steel used in the tools. Average estimates may be set down at 18 ft. per minute for turning or planing cast steel. Cast iron can be cut 10 or 15 per cent. faster. Brass may be turned at 60 ft. per minute. It need hardly be stated that the quality of the metal must also be taken into consideration, and further, that it takes men of large experience and good judgment to get the best results out of the material and machinery at hand, and that the output at one shop should not be compared with that at another place unless all of the conditions are alike.



MASON 2-6-3 ON THE OLD NEW YORK & MANHATTAN RAILROAD.

When cars have been scarce men engaged in train service have often marvelled why rules were not introduced permitting cars to be loaded for any destination instead of being hurried empty, if necessary, to the home road. There is now a movement on foot to introduce the practice of loading cars to any place without regard to the direction of the home road. This will add materially to the number of cars available for loading in times of scarcity of cars.

Black Smoke.

An important decision was recently given in a police court in London, England, in regard to a complaint brought by the Chelsea Borough Council against the Underground Railway Company for an alleged smoke nuisance at the station at Chelsea. Expert testimony was given to show that the smoke was not black as was alleged, and the magistrate dismissed the complaint, awarding the railway company three hundred guineas as costs. This should be a wholesome lesson to those smoke-consuming enthusiasts whose reiterated complaints amount in many cases to industrial persecution.

Air Brake Department

Some Defects of the E. T. Brake.

By G. W. Kiehm.

The manner in which all Westinghouse brake valves control the flow of air to and from the brake pipe is identical, and the disorders which result from neglect are similar.

The functions of a triple valve, brake cylinder, and auxiliary reservoir are manifest in the operation of a distributing valve, and the cause of any improper action can be ascertained by comparing them.

The work of the brake and the distributing valves of the E. T. equipment depend upon each other to such an extent that the defects of one cannot be pointed out without reference to the other.

Suppose then, that a brake is found, that will not apply either with the automatic or independent application when there is pressure on the independent valve and the automatic valve is cut in.

If the distributing valve is not cut out, and the application is not accompanied by a falling of the red hand of the air gauge, and an increased speed of the pump, it will indicate that no air is escaping through a brake cylinder, or broken brake cylinder pipe, and it is safe to assume that the application valve has not moved on account of being broken off from the main piston, or the main piston being stuck.

If the brake will not apply during a service application, but will apply when used in the direct application position, it is usually due to a stuck equalizing valve, a loose equalizing valve packing ring, or a leaky packing leather and ring on the main piston. The leak past the packing leather can be detected by holding a torch to the exhaust port of the distributing valve while the service application is made.

The leaky triple piston packing ring is always associated with failure to release, flat and broken wheels, but the leaky equalizing valve packing ring will be first noticed in service applications, as the air contained in the small pressure chamber will pass the ring very quickly, and the increase of pressure in the brake pipe on the engine at the moment of release, will be more rapid than the decrease during a service application.

This failure of the brake to apply during service applications may be due to a leaky equalizing piston packing ring in the brake valve, and it should be observed that the piston is lifted from its seat and the brake pipe pressure reduced, before deciding that the distributing valve is at fault.

Where the brake valve cut-out-cock is located in the brake pipe, a test for a leaky packing ring can be made by closing the cock and making a full service reduction. The pressure in the small space between the cut-out-cock and the equalizing piston will lift a piston with a neatly fitted ring. If the piston is not unseated the air in this space must have passed the ring and escaped through the preliminary exhaust port or leaked out of the union connection under the brake valve. The cut-out-cock may be leaking, which would interfere with the test. It can, in turn, be tested by charging the brake pipe, closing the cock, and placing the valve handle in emergency position. A leak from the emergency exhaust port at this time would be from the cut-out-cock. In making this test with the H 5 brake valve, the pressure would have to be withdrawn from the application chamber and equalizing reservoir on account of the connection between the two in this position, otherwise a leak past the equalizing piston packing ring would also be free to escape at the exhaust port.

When the cut-out-cock is located in the reservoir pipe, the leakage past the packing ring can be ascertained by charging the brake pipe, placing the handle on lap, and having the brake pipe pressure withdrawn suddenly. The fall of the black hand will show approximately the packing ring leakage. If the automatic brake applies and the independent will not, the independent brake must be at fault; either the reducing valve has failed to open or some obstruction prevents the flow of air to the application chamber. If the automatic brake leaks off with the valve handle on lap, there must be a leak in the application chamber or the pipe connections. If the independent brake leaks off when the handle is placed on lap, the leak is usually past the valve seat of the safety valve. If the brake cylinder and pipe connections are tight, the distributing valve will exhaust the brake cylinder pressure as the application chamber pressure reduces, but if the brake cylinder leaks can reduce the pressure as fast or faster than the application chamber prescure reduces, the brake will leak off without giving any warning.

When a brake applies in full after a light reduction it is usually due to a leaky brake pipe, although it can be caused by a leaky graduating valve in conjunction with a leaky equalizing valve packing ring. The H 6 brake can be applied by a leaking and overcharged brake pipe; the H 5 cannot. Either brake may be stuck if the application valve should break off or the main piston become stuck, in application position. As the slide valve of a triple valve will leak and waste air at the triple exhaust port, so will the slide valves of a distributing valve leak and waste air at the exhaust ports. The application valve may leak while the main piston is in either position. When in release the leak will show at the exhaust

N. Y. C. APPRENTICES. CORNER OF DEMONSTRATING ROOM.

port, when in application position it will build brake cylinder pressure beyond that in the application chamber, and if the volume of leakage is sufficient, and no leakage exists in the brake cylinders, the exhaust valve will move toward release position and allow air to escape to the atmosphere.

The exhaust valve leaking will also show in application position. If a leak ceases after a leak has been started in the brake cylinder pipes, the leak must have been from the application valve. The blow from a leaky equalizing slide valve will show at the emergency exhaust port of the brake valve when the handles of both valves are in running position, and when the handles are moved from running position this pressure will increase in the application chamber and apply the brake. The leak at the brake valve exhaust port may be from the independent brake valve or from the rotary seat of the automatic valve. If the handle of the automatic valve is placed on lap and a leak at the emergency exhaust port exists, it indicates a leaky rotary valve. If the leak is from the independent brake valve and an independena application is made, the application chamber pressure will not increase beyond the adjustment of the reducing valve. If the leak is from the equalizing slide valve the pressure will increase until the safety valve opens and exhausts it to the atmosphere.

If any doubt exists as to where the blow is from, the equalizing slide valve of the H 5 equipment can be tested by withdrawing the brake pipe pressure and placing the handle on lap. If the cut-out-cock is turned and a leak exists at the emergency exhaust port it must be from the slide valve.

As the lower body gaskets of the brake valves become dry and hard and finally crack, a leak can occur from the chamber above the equalizing piston to the application chamber port. This would also show at the emergency exhaust port when the brake valve handle is in running position and would have about the same effect as a leak in the equalizing reservoir or gauge pipe.

The gasket breaking between the chamber above the equalizing piston and the double heading port could interfere with the equalizing slide valve test, hence the reason for withdrawing all the brake pipe pressure.

The equalizing slide valve of the H 6 equipment can be tested by overcharging the brake pipe and withdrawing enough brake pipe pressure to apply the brake. With the handles in their running positions the slide valve will then lap the exhaust port and be open to the atmosphere through the brake valves.

Moisture in the application chamber will rust the tubes which conduct the flow of air to and from the distributing valve. If the tubes become defective and leak into the application chamber the effect will be similar to that of a leaky equalizing slide valve. The tubes can be tested by withdrawing the brake pipe pressure and closing the cocks in the supply and brake cylinder pipe, and then removing the distributing valve. The reservoir tube can be tested by plugging the exposed port and opening the cock in the supply pipe; the brake cylinder tube in the same manner, and the brake pipe, too, by plugging the port and recharging the brake pipe.

N. Y. C. APPRENTICE CLASS ROOM, WEST ALBANY.

The drain plug in the pressure chamber has a standard ⅜-in. pipe thread, and by a series of bushings, a nipple, socket, and a ¾-in. signal hose, the pressure chamber can be connected with the signal line between the engine and tender, and by plugging the port through which air will then be escaping, the wall between the chambers and the remaining tube can be tested.

A leak in the brake cylinder tube would have a tendency to destroy the automatic application. It could show no leak at the brake valve, and it will be seen that its effect will depend entirely upon the amount it leaks.

A leaky graduating valve may not be discovered until the engine is the second one double heading. It may not be noticed then, as the work it performs is similar to that of the graduating valve of a triple valve. The graduating valve is used to divide the two reservoir chambers and lap the port leading to the safety valve when the distributing valve is in service lap position. If the safety valve is removed at this time a leak into the passage into which it is screwed must be from the graduating valve, assuming that the slide valve is tight.

It will be noticed that the H 6 brake develops a higher brake cylinder pressure, when used in the direct application position, than does the H 5.

The distributing valve is so constructed that when the equalizing valve travels its full stroke and compresses the spring in the cylinder cover, the flow of air to the application chamber is cut off and the pressure chamber air expands into the main piston cylinder chamber. Equalizing with the small chamber gives a higher pressure, and when the equalizing valve is again forced to its release position by placing the valve handle in train brake release or driver brake holding position, the application cylinder air will equalize with the application chamber which has practically no pressure, and the brake cylinder pressure will fall to 12 or 15 lbs. The release and service application features of the two valves are the same.

The pressure for the independent brake and signal system is controlled by the same valve, and a check valve prevents a backward flow from the signal system. During an indpendent application a leak in the signal system is likely to result in a blast from the whistle, which is an excellent arrangement, as the signal whistle calls attention to the fact that a leak exists or that the action of the reducing valve is erratic.

To Trap the Chancetaker.

A new signal system, said to be the invention of a Pittsburgh man, is being tested on the Long Island Railroad. By this system, it is said, a cartridge will explode if an engineer should run past a danger signal, thus calling it to the attention of men in the cab.

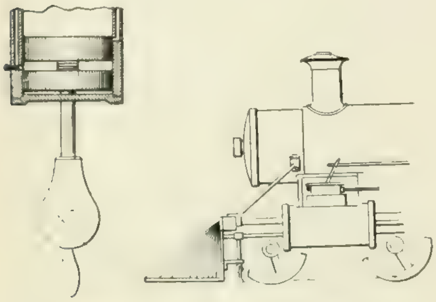
The explosion of the cartridge will also record on an indicator the fact that an engineer has neglected to observe a danger signal and explanations will be in order from the man at fault.

Don't tell what you are going to do; do it.

Patent Office Department

SIGNAL SYSTEM.

Mr. Harry L. Rider, Oil City, Pa., has patented an electrical signaling system for railways, No. 870,466. The object of the invention is to prevent the possibility of collision by reason

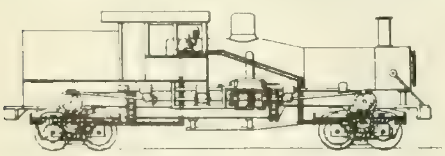


AUTOMATIC STOP SIGNAL.

of the failure of the engineer to observe or obey a danger signal, by providing means for automatically applying the brakes and stopping the train. The invention embraces an improved valve and contact device carried on the locomotive, and also a track stop plate and its connections. There is a stop plate at the entrance and exit ends of each section and are adapted to be struck by a lever depending from a valve casing carried by the locomotive which automatically operates the air brake and stops the train. Each train simultaneously operates an advance signal and a rear signal, and is thus protected from collision from either direction. Electric batteries operate the signals. Our illustration shows contact device depending from the locomotives.

LOCOMOTIVE.

A new form of geared locomotive has been patented by Mr. J. E. Friermood, Everett, Wash., No. 870,769. In the locomotive there is a combination

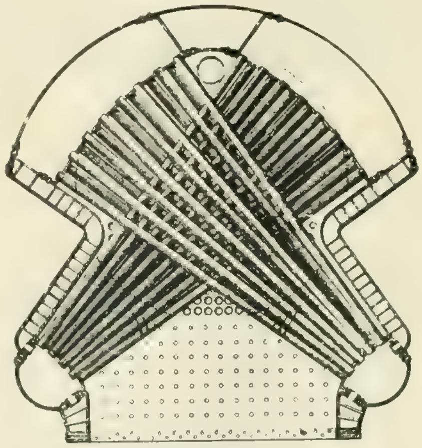


GEARED LOCOMOTIVE.

with the engine frame, truck frames, and axles, of driving mechanism mounted on the engine frame, axle gears of different diameters mounted on adjacent axles, an intermediate gear supported from the axles independently of the engine frame or truck frames and shiftable into engagement with either axle gear, and gearing between the driving mechanism and the intermediate gear, the gearing including a shaft having flexible connected sections.

LOCOMOTIVE FIRE-BOX.

Mr. J. M. McClellon, Everett, Mass., has patented a fire-box for locomotives, No. 870,380. The boiler is furnished with inner and outer sheets, the inner sheet being outwardly curved at its top. There is a longitudinally extended drum at each side at the bottom, and water tubes connecting each drum with the space between the inner and outer sheets, the water tubes extending



WATER-TUBE FIREBOX.

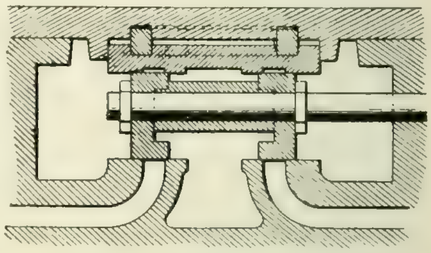
from one drum crossing those that extend from the other drum, and the water tubes that extend from each drum being nearer together at their lower than at their upper ends.

Sanitary.

In the course of a suit brought by a Pullman porter for damages on account of personal injuries, the statement was made that the monthly income of the man from tips was about $30. The tendency to prohibit porters from brushing passengers inside the cars will have a dolorous effect upon the Pullman porters' income. The whisk broom is usually hidden by the porter and is only produced when the train approaches "tipping" stations. The growth of sanitary science may abolish this practice.

BALANCED VALVE.

Mr. J. H. Woodring, Corry, Pa., has patented a balanced valve, No. 870,073. The device embraces a combination with a steam chest of a sliding valve comprising a rectangular body with side and ends, an integral sleeve connecting the sides and communicating

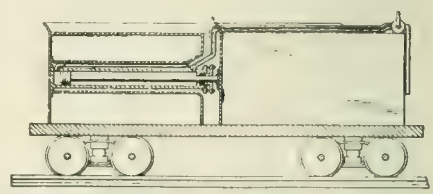


BALANCED SLIDE VALVE.

with the outer surfaces, the sleeve being designed to receive the valve rod. A wear plate is imposed on the valve and formed in its upper surface with an annular groove, the steam chest having one of its walls formed with a groove aligning the first-named groove, and a packing ring having portions disposed in each of the grooves.

LOCOMOTIVE TENDER.

An improved locomotive tender has been patented by Mr. M. E. Petty, Chicago, Ill., No. 870,840. The device embraces a combination with a tender of a follower formed of hinged sections, one of which is free to swing forwardly, the follower being arranged for sliding movement in the coal pit of of the tender, the follower comprising a back plate and facing boards. There is a cylinder arranged within the tender and a piston arranged for moving in the cylinder, the rod of the piston being connected with the follower. Steam supply pipes lead to each end of the cylinder.



TENDER WITH MOVABLE COAL BOARDS.

If thou wouldst have aught of good have it for thyself. And faithfulness is thine and reverence is thine, who then can rob thee of these things? Who can hinder thee to use them, if not thyself?

Atlantic for the New Haven.

The New York, New Haven & Hartford have recently procured some Atlantic and some Pacific types of locomotives from the American Locomotive Company. Our illustration shows one of the former, or 4-4-2 type, which are used on the five-hour trains between New York and Boston.

The engines are simple, with cylinders 21 x 26 ins. and 79 in. driving wheels. The tractive effort exerted at full stroke and low speed amounts to about 24,700 lbs., and with 105,500 lbs. adhesive weight the ratio of tractive effort to driving wheels load is as 1 is to 4.2. The valve gear is Walschaerts and actuates ordinary slide valves of the Richardson balanced type. These valves are set with 5-16 lead which is of course constant with this style of valve motion. The steam lap is 13-16 in., 1/8 in. exhaust clearance and a valve travel of 6 7/8 ins. The motion of the valve rod has been very neatly arranged for by a small crosshead moving upon a guide placed between the yoke and the steam chest. Our half-tone illustration was made from a photograph in which the valve rod and the lifting-shaft arm happen to be exactly in line. There is no lifting-arm hanger in this case, but the end of the lifting arm is forked and provided with a sleeve in which the end of the valve rod moves in and out. This arrangement is compact and economical of space.

The weight of the engine in working order is 200,000 lbs., and with the tender the total weight goes 334,000 lbs. The wheel base of the engine is 28 ft. 2 ins.; the rigid base, which includes drivers and carrying wheels at the rear is 16 ft. 9 ins., and the driving wheel base is 7 ft. 3 ins. The wheel base of engine and tender is 56 ft. 1 in.

The boiler of this engine is of the extended wagon top variety and is 67 1/4 ins. in diameter at the smoke box end. The taper course is the second and slopes up to 74 ins. The dome is on the third barrel course and is well forward of the firebox. The heating surface in the arch tubes is 27.7 sq. ft., in the firebox it is 185.5, and in the tubes 3,041.3, making a total of 3,254 1/2 sq. ft. The grate area is 53½ sq. ft., and this gives a ratio of 60.8. The working pressure carried is 200 lbs. The firebox is 108 1/8 ins. long and 71 1/4 ins. broad. The distance between the flue sheets is 16 ft. 10 ins. There are 347 tubes 1/8 in. thick.

The tender tank is of the usual U-shape and holds 6,000 gallons and carries 14 tons of coal. The tender trucks are of the diamond arch bar type with 36 in. Paige plate wheels and 5 1/2 x 10 in. journals. The carrying wheels of the engine are 51 ins. in diameter with outside journals 8 x 14 ins. The engine truck wheels are like those of the tender with 6 x 12 in. journals. Some of the principal dimensions are appended for reference:

Driving Journals—Main 10x12 ins.; others 10x12 ins.
Firebox—Thickness of crown, 3/8 in.; tube, 1/2 in.; sides, ⅜ in.; back, ⅜ in.; water space, front, 5 ins.; sides, 4 ins.; back, 4 ins.
Crown Staying—Radial tubes 2 ins. outside diameter.
Boxes—Driving, main cast steel.
Air Pump—9 1/2 ins. L. H. 2 reservoir 130 in. x 1 20-1/2 in.; 1-14 in. x 60 in.
Engine Truck—4 wheel swing bolster.
Trailing Truck—Rigid with outside journals.
Piston—Rod diameter 3 1/2 ins.
Tender Frame—10 in. steel channels 8.23 w. b.

ATLANTIC TYPE ENGINE FOR THE NEW YORK, NEW HAVEN & HARTFORD RAILROAD.

Geo. W. Wildin, Mech. Supt. American Loco. Co., Builders.

Daily Press Railway News.

Two lively black kittens without a white hair on either were playing about the roundhouse below Red Bank, on the main line of the New York & Long Branch Railway one morning when just as one of the engines was about to start one chased the other up the cowcatcher, and both sat there unnoticed.

The engine steamed down to Point Pleasant, and there hitched up to one of the fast New York expresses and brought it along. The kittens rode all the way down and back sitting steadily enough in the middle of the pilot plate, just below the headlight, but causing no little excitement among the railway men and passengers who spied them.

As they were already far from their mother's care before they were discovered and seemed to be enjoying the ride, they were not molested until the flier reached East Long Branch. Then one of them had enough and dropped off when the train stopped.

The other stayed where he was until the end of the run. The wires having caried unofficial announcements of the kittens' progress, it was not long before an inquiry came from down the line as to what should be done with the other.

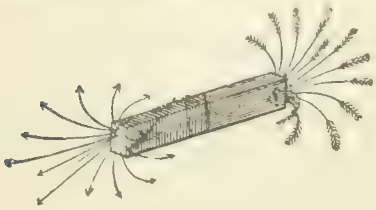
"Don't separate 'em. Send him up by the next train," was the answer.

The babies seemed glad to get together again, but they were hungry. One of the steamers was at her pier, but a quick inspection of her commissary stores showed nothing more appetizing than condensed milk. The kittens still mewed pitifully, so by and by an idle engine went clanging down the long pier, around the foot of the hill into the town. When she came back she brought a bottle of mixed cream and milk.

One of the kittens travelled sixty-five miles and the other fifty-eight miles on the cowcatcher, according to the railwaymen's figures.—*Montreal Witness.*

Magnetic Lifting.

An ordinary horse-shoe magnet such as a schoolboy prizes as one of his greatest treasures, and which can be bought for a trifle in any hardware



FLAT BAR MAGNET.

shop, possesses the property of attracting light bits of iron and steel, and this property has been applied commercially to electro-magnets used in railway shops and manufacturing establishments. The pocket magnet is supplied with what the schoolboy calls a "keeper." This is simply a small piece of soft iron which when applied to the ends of the magnet is held there very firmly. The ends of the horse-shoe magnet are called the poles of the magnet and the "keeper" is the armature, and in the case of the commercial or lifting magnet it corresponds to the load.

As an illustration of how the magnet, be it large or small, is able to hold onto bodies of steel or iron, with sufficient tenacity to enable them to be lifted and carried about, we may suppose that there are what are called lines of force, which, when the magnet is active, extend from one pole to another and pass through the keeper, or the armature, or the weight to be lifted, as the case may be. The action of the lines of force may be pictured in the mind as an almost infinite number of threads, any one of which possesses comparatively little strength, but which, like the minute strands with which the Liliputians securely bound the giant Gulliver to earth, have in the aggregate very considerable strength.

BOY'S HORSESHOE MAGNET.

The lines of force do not, however, pass around the body, as the ropes of the little people did when binding Gulliver down. The lines of force go through the object and hold it close up to the poles of the magnet. It is just as if one had a loaf of bread, and with a long needle passed each thread through the loaf, fastened the ends to the magnet poles, and thus sewed the bread through and through an indefinite number of times. In the case of the pocket magnet these invisible lines of force are present all the time, but when an electro-magnet is used, the lines form or disappear, as the current flows or dies, and at a touch the innumerable stitches are there, or they are gone, with the velocity of light itself.

Structurally the lifting magnet as made by the Cutler-Hammer Clutch Company of Milwaukee, Wis., consists of a circular case of cast iron or steel, in which is embedded a coil of copper. In a general way the lifting magnet may be likened to a spoked engine truck wheel with a steel tire. There is a central hub with a hole through it like the wheel hub bored out for the axle. The part or zone where the spokes of the wheel lie, is, in the magnet, occupied by the circular coil of copper, and the tire of the wheel corresponds to the protecting outer case of the cast shell of the magnet. The face of the magnet, which is the lower surface, consists of a central ring of cast iron, about which lies a ring of brass hold-

THE 50-IN. LIFTING MAGNET.

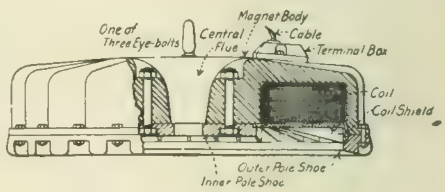
ing the coil in place, and beyond that there is an outer ring of cast iron. The outer and inner rings of iron are called the outer and inner poles, and the brass ring is called the coil shield. This brass ring, being non-magnetic, compels the lines of force to form below the coil and to stretch across the gap which separates the poles.

The mushroom casting which forms the body of the lifting magnet is cored out in the center like the hub of a wheel. This opening forms a sort of central flue which helps to carry off the heat which is generated when the coil is energized by the flow of the electric current. The outer edge of the casting is corrugated in order to present a larger heat radiating surface so that the magnet, as a whole, may be kept cool. This is one of the features of the design, for other things being equal, the cooler the magnet can be kept, the greater its efficiency. The heat radiating corrugations have been cleverly used in another way. They provide recesses for the bolts which hold the removable outer pole shoe, and when snugly in place they are not liable to be struck or broken by projecting pieces of material.

If this lifting magnet was sliced through the center its section would appear like a couple of horse-shoe magnets resembling the inverted letters Ω Ω. As this is a typical section cut across at random, it follows that the whole magnet is practically an infinite series of horse-shoe magnets arranged in the form of a circle, with, let us say, all the "north poles" touching each other, and all the "south poles" forming the outer edge.

One of the principal advantages in the use of an electric lifting magnet is the rapidity and certainty with which it takes hold of a load. The magnetic "grasp," if we may so call it, does away with the necessity for tilting up or lifting an object and passing a sling chain round it, and, moreover, as the sling is liable to chafe or damage certain objects, the absence of a sling is an obvious advantage. A number of objects which can only be lifted either in bundles or after having been placed in a basket or bucket, are readily taken up by the lifting magnet without any previous arrangement or adjustment.

Stamped steel pieces, pig iron, rails, bars, plates, etc., are taken up *en masse* and transported in bulk as one might say, while single pieces, even when closely surrounded by other material in a crowded yard may be taken hold of and fished out by a shop crane whose tackle is baited with a lifting magnet. The holding power of this style of magnet is such that one of them 50 ins. in diameter can sew a mass of metal with lines of force so thoroughly that a weight of 10 tons will hang from the

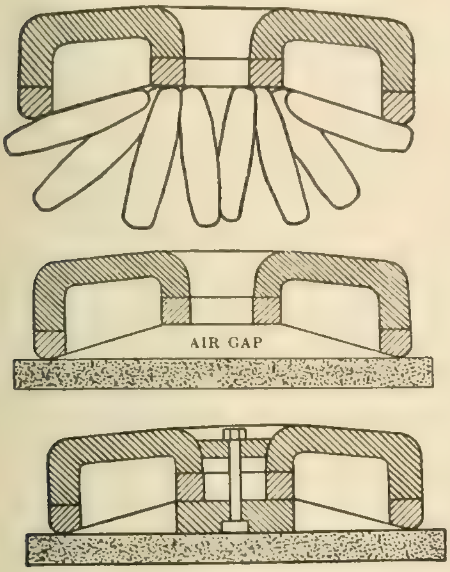


SECTION OF LIFTING MAGNET.

energized magnet. A 10-in. magnet, which is a handy size in a shop, weighing itself about 75 lbs., can support a weight of a ton or more.

The lifting electro-magnet, one might almost say, is the logical consequent of the electric crane. Cables from the crane trolley come down to the magnet, and without being strained, have practically the same length as the hoisting chain of the crane. A cleverly arranged small electric motor reels up

the cables as fast as the crane chain goes up with the load, and again keeps pace with the chain when swinging down for another lift. The switch by which current is turned on or off the lifting magnet is within easy reach of the operator and is made sufficiently stiff to require a definite and purposive action on the part of the man in charge when he wishes current to flow. The chance of the current being accidentally



MAGNET ARRANGED FOR LIFTING PIG IRON AND FOR FLAT PLATE.

cut off with load in midair is thus reduced to a minimum.

Large lifting magnets have been specially designed for handling pig iron. These are slightly concave on the under side, as this form has been found most satisfactory for handling large numbers of irregularly shaped pieces. When large objects with plane surfaces have to be lifted, the concavity would produce an air gap between the inner or central pole and the flat surface of the load. This air gap can be removed by the insertion of an auxiliary pole piece bolted to a yoke which fits into the central aperture of the magnet.

The efficiency of the large pig-iron-lifting magnet may, as story writers say, be more easily imagined than described when one thinks of the laborious work and the slow, tedious march of two men at so much an hour, carrying one iron pig at a time, as compared with the masterful grip of the electric crane as it dips down its magnetic finger tips and lifts up a giant handful of iron ingots or a sheaf of steel stampings and rolls away with the work of hours in a single lift.

Holy Stone.

Holy stone and rotten stone are used, as everybody knows, for scouring or polishing metal. Rotten stone is a soft easily broken substance, which consists largely of silicious limestone in which most of the limestone has, in the process of weathering, been washed or drained away. The process in nature is not unlike the separation of ashes from cinders, which would take place in a pile constantly exposed to the rain. The ashes would be said to have leached out, and rotten stone is what remains of this fine silicious limestone after the greater part of the lime has leached out.

Speaking of the origin of the name Holystone, the Dundee *Advertiser* says: "At the Reformation, when the Church of St. Nicholas, at Yarmouth, was despoiled, the carved stones of many of the monuments, both in the church and outside in the graveyard, were shipped off—some to Newcastle, to be turned into grindstones, and some on board the ships of the royal navy of the day, to be used in scouring the decks, whence, it is interesting to know, the seamen's term 'holystoning the deck' takes its origin."

All-Steel Coach for the U. P.

With the idea of bettering the present passenger equipment, and to provide greater safety for passengers and trainmen, the Union Pacific Railroad have designed and built a steel fireproof passenger coach that marks a wide departure from the familiar old-style passenger car. The length over vestibule diaphragms, 68 ft., is the same as the present standard 60-ft. coach. A decrease in height from rail to roof of 24 ins. is but one of the changes from the regular equipment.

The underframing is composed of two 12-in. I-beam center sills, 16-in. centers, and 6 x 3½-in. angle iron side sills, all securely fastened by cross ties, needle beams and diagonal bracing. The 12-in. center sills are to take the buffing and pulling stresses, and in reality do not carry any load, as they themselves are carried by the sides of the car, which really form continuous girders. The double body-bolsters, end sills and end bracing of the underframe are made of a one-piece steel casting, 11 ft. long by 9 ft. 9 ins. wide, weighing 3,700 lbs.

On top of the underframing is riveted a course of 1-16-in. sheet steel, forming a fire protection from below. On these steel sheets is a layer of ¾-in. hair felt, and on top of this is a flooring of fireproof composition made in the form of pressed sheets 3 by 4 ft. by ½ in. thick, laid on nailing strips ¾ by 2 ins., embedded in the hair felt. The whole floor construction is securely bolted together by small stove bolts, the heads being let in flush with the top of the floor.

The side posts and carlines are one continuous piece composed of 3-in. channel iron, bent in the form of an inverted letter U, extending from side sill to side plate, forming the contour of the half-oval-shaped roof, and extending down to the side sill on opposite side of car. To these channel iron posts, which are formed with flat side outward, is riveted the ⅛-in. steel side sheathing, which, with the posts, is riveted to the angle iron side sills. The steel sheathing extends from bottom of the side sills to top of the 4-in. channel side plate, forming a deep, substantial girder, which is additionally stiffened by diagonal braces placed below the circular windows and riveted to the sheathing.

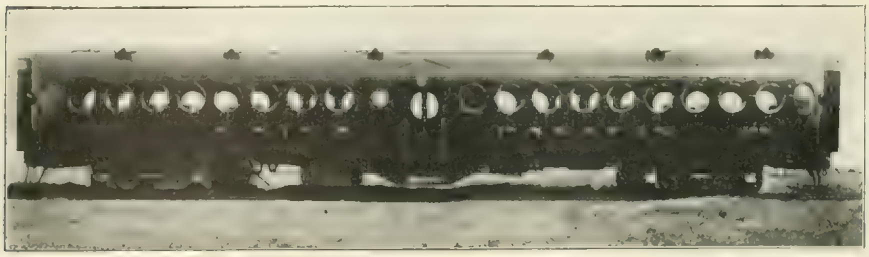
The usual form of square wooden window sash, and Gothic sash at the sides of car have been discarded for a circular aluminum sash with a 24-in. glass. This metal sash, provided with a half-round rubber gasket forms an absolutely weather and dust-proof window. These circular windows are similar to the porthole of a steamship. They are hinged at the top. When open, they are swung up to the ceiling and secured by a catch. The deck sashes or clearstory lights, and indeed

LIFTING UP A GREAT SHEAF OF STEEL STAMPINGS.

the entire upper deck of the usual type, have been replaced by a roof, forming a half-oval, beginning at the top of the 4-in. channel side plate on one side of car, and extending to the opposite side. This design of roof has been very successfully used on all of the gasoline motor cars built by the Union Pacific, and gives lightness, strength, and low cost of construction, together with simplicity and beauty of design.

The interior arrangement differs from

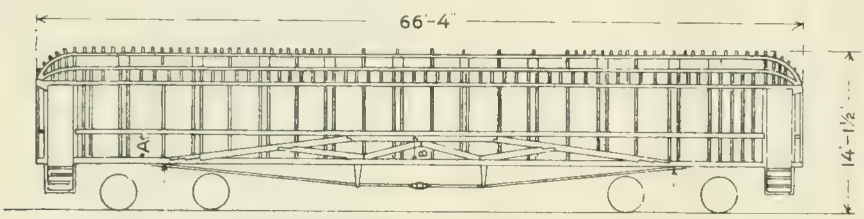
usual practice In the first place the four vestibule entrances, the steps, of the ordinary coach, have been replaced by a single vestibule across the center of the car where the side entrances are.



NEW UNION PACIFIC STEEL PASSENGER CAR.

This side entrance has been found very satisfactory in the company's gasoline motor cars. Both ends of the coach are rounded in order to lessen wind and air resistance, and the usual end doors have been retained in order to allow a continuous passage through the train. The rounded car ends may possibly give an account of themselves in the event of a collision or serious derailment. Telescoping is not likely to take place with stiffly built steel cars, but it is possible that if violent dislocation of the cars took place the rounded ends would facilitate the sliding of one car past another.

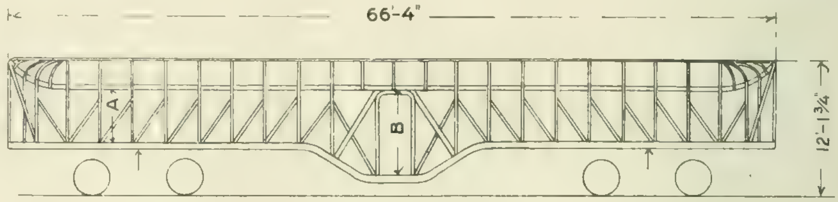
All partitions and inside walls of the car are ¼ in. thick, and the ceiling ⅛ in. thick, and all are of the same fireproof composition as the floor. The thickness of the walls of the car are worthy of note, being only 2 ins. from outside sheathing to the finished surface of the interior wall. This reduced thickness of walls means an increase of 7 ins. in width of aisle. Very



SIDE FRAME OF AN ORDINARY PASSENGER COACH.

little wood enters into the construction of the car; only about 200 lbs. of wood for small filling blocks is used. All mouldings, etc., are made of fireproof material.

In the ventilating system, air is admitted at the round ends of the car, through openings about 8 ft. from the rail, placed at each side of the end doors. These intakes are 12 ins. in diameter, covered with a fine brass netting; thence the fresh air passes downward to an air-tight galvanized iron box placed beneath car which contains two sets of removable dust collecting screens set vertically. These screens keep dust and foreign substances from entering the car. After passing through these screens, the purified air is admitted to the inside, and goes along the sides of the car, through a galvanized sheet duct having perforations at each seat. Along the outside of this fresh air duct are placed the steam heating pipes, which heat the incoming air. The amount of fresh air admitted to the car is regulated



SIDE FRAME OF U. P. STEEL CAR WITH CENTRE DOOR.

by dampers in the intakes at the car ends.

The lighting equipment consists of an electric generator, placed on one of the trucks and belted to a pulley on axle. An auxiliary storage battery has been placed in steel boots below the car floor. At each seat is placed an eight candle-power lamp, with frosted globe. The drinking water is contained in a large, flat, galvanized iron tank, set vertically, and placed back of a removable partition at the center of the car. From this tank, which is filled by a hose fastened at a connection at side sill of car, the water flows through a coil of pipe placed in an ice box within the vertical tank, to the water alcove, at the center vestibule.

In regard to weight, this coach is lighter than the generally designed all-steel coach, with an equal seating capacity or length. It shows a weight per passenger of 1,145 lbs. The car was designed and built under the personal supervision of Mr. W. R. McKeen, Jr., Superintendent of Motive Power and Machinery of the Union Pacific Railroad. Some of the principal dimensions are as follows:

Actual weight, 80,100 lbs.; length over diaphragms, 68 ft.; height rail to roof, 12 ft. 1¼ ins.; height floor to ceiling, 7 ft. 8¼ ins.; width inside at wainscot, 9 ft. 5⅝ ins.; width of aisle between seats, 3 ft. 5⅝ ins.; width of car over side sills, 9 ft. 5⅝ ins.; roof sheets, galvanized iron, 1-16 in. thick; truck, 4-wheel cast steel; seating capacity of coach, 78 persons.

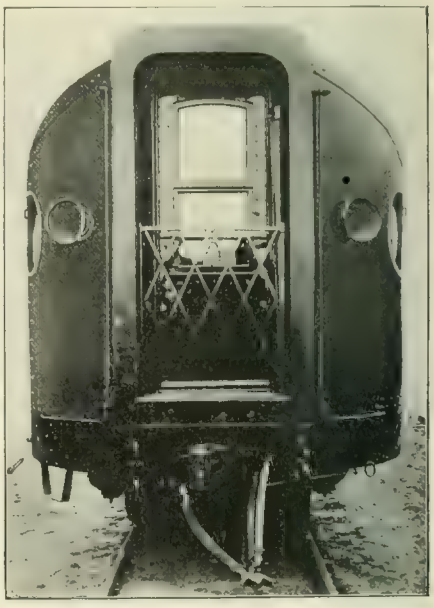
Helped Edison to Catch On.

Thomas A. Edison was one day explaining an intricate machine to a newspaper writer.

"I know I am very green as regards machinery," the reporter said apologetically.

"Oh, I have seen greener," said Mr. Edison. "Did I ever tell you about the fireman I once met in Canada?

"Well, in a certain Canadian town where I was running a telegraph office in my youth a new factory, with a very fine engine house, was put up. I visited this factory one day to see the engine. The engineer was out, and the fireman showed me about. As we stood admiring the engine together I said:



ROUNDED END OF U. P. STEEL COACH.

"'What horsepower has this engine?'

"The fireman gave a loud laugh.

"'Horsepower?' he exclaimed. 'Why, man, don't you know that the machine goes by steam?'"—*N. Y. Tribune.*

Items of Personal Interest

Mr. S. O. Dunn, formerly associate editor of the Chicago *Tribune*, has been appointed managing editor of the *Railway Age*.

Mr. J. Kyle has been appointed master mechanic on the Canadian Northern Railway with headquarters at Edmonton, Alta.

Mr. F. Wilson has been appointed locomotive foreman on the Canadian Northern Railway, with headquarters at Humbolt, Sask.

Mr. J. A. Zeller has been appointed traveling fireman on the Western division of the Pennsylvania Railroad, with office at Fort Wayne, Ind.

Mr. J. T. Nedwideck, trainmaster of the Missouri Pacific-Iron Mountain Railway at De Soto, has been transferred to Poplar Bluff.

Mr. R. F. Doxey has been appointed master mechanic on the Des Moines, Iowa Falls & Northern, with headquarters at Iowa Falls, Ia.

Mr. J. M. McCarthy has been appointed purchasing agent of the Chicago, Rock Island & Pacific, with headquarters at Chicago, Ill.

Mr. W. A. Walker has been appointed locomotive foreman of the Canadian Northern at Dauphin, Man., vice Mr. F. Wilson, transferred.

Mr. N. L. Smitham has been appointed master mechanic of the Texas Midland, with office at Terrell, Texas, vice Mr. O. W. Lewis, resigned.

Mr. F. W. Schulz has been appointed master mechanic of the Missouri Pacific-Iron Mountain at McGehee, Ark., vice Mr. I. T. Johns, resigned.

Mr. W. H. Dooley, master mechanic of the Cincinnati, New Orleans & Texas Pacific, at Somerset, Ky., has been transferred to Birmingham, Ala.

Mr. T. O. Sechrist, master mechanic of the Cincinnati, New Orleans & Texas Pacific at Chattanooga, Tenn., has been transferred to Somerset, Ky.

Mr. J. R. Dolsen, foreman of the car department of the International & Great Northern shops at Palestine, has resigned to engage in other business.

Mr. J. L. Kendrick has been appointed foreman of the mechanical department of the Buffalo, Rochester & Pittsburgh at Punxsutawney, vice Mr. H W. Williams, promoted.

The office of Mr. S. W. Mullinix, superintendent of motive power on the Chicago, Rock Island & Pacific, has been moved from Topeka, Kan., to Horton, Kan.

Mr. G. Gasford has been appointed district master mechanic on the Canadian Pacific Railway, with headquarters at Cranbrook, B. C., vice Mr. R. D. Smith, resigned.

Mr. A. A. Sheppard has been appointed acting locomotive foreman on the Canadian Pacific Railway, with office at Schreiber, Ont., vice Mr. G. F. Morton, transferred.

Mr. Wayne A. Clark, formerly assistant engineer of the Duluth & Iron Range, has been appointed chief engineer on the same road, vice Mr. Robert Angst, deceased.

Mr. O. Cornelisen has been appointed general superintendent of the Chicago Great Western Railway, with headquarters at St. Paul, Minn., vice Mr. G. A. Goodell, resigned.

Mr. F. E. Paradis has been appointed to the new office of engineer of the Western district of the New York Central & Hudson River Railroad, with office at Buffalo, N. Y.

Mr. H. McLeod, formerly road foreman mechanical department of the Canadian Northern Railway from Port Arthur, Ont., to Winnipeg, Man., has been assigned to other duties.

Mr. J. Y. Hill, formerly trainmaster of the Northern Alabama, has been appointed engineer of maintenance of way of the Southern Railway, with headquarters at Birmingham, Ala.

Mr. J. T. Carroll has been appointed assistant master mechanic on the Lake Shore & Michigan Southern Railway, with headquarters at Collinwood, Ohio, vice Mr. O. M. Foster, promoted.

Mr. J. W. Senger has been appointed supervisor of material of the Lake Shore & Michigan Southern and the Lake Erie & Western and the Lake Erie with office at Collinwood, Ohio.

Mr. W. H. Williams has been appointed master mechanic of the Buffalo, Rochester & Pittsburgh, with headquarters at East Salamanca, N. Y., vice H. C. Woodbridge, transferred.

Mr. G. W. Sheasley has been appointed master carpenter of the Monongahela division of the Pennsylvania Railroad, with office at Ormsby, Pa., vice Mr. Robert McKibben, transferred.

Mr. A. Short, formerly machine shop foreman on the Canadian Pacific Railway at Calgary, Alta., has been appointed general foreman on the same road, vice Mr. S. Newmarch, resigned.

Mr. C. B. Gifford, master mechanic of the Louisville & Nashville shops at Mobile, Ga., has resigned, and will herafter devote his time to raising oranges in Florida, where he has a large grove.

Mr. D. D Briggs, assistant master mechanic of the Louisville & Nashville at Montgomery, Ala., has been appointed master mechanic at Mobile, Ala., on the same road, vice Mr. C. B Gifford, resigned.

Mr. W. H. Towner, formerly locomotive foreman on the Grand Trunk Railway at St. Thomas, has been appointed locomotive foreman on the same road at Sarina Tunnel, Ont., vice Mr. W. Gell, promoted.

Mr. A. L. Hertzberg, engineer of maintenance of way, has been appointed engineer of the Ontario division of the Canadian Pacific with headquarters at Toronto, Ont., vice Mr. J. M. R. Fairbairn, transferred.

Mr. W. Gell, formerly locomotive foreman on the Grand Trunk Railway at Sarina Tunnel, Ont., has been appointed master mechanic of the Ottawa division on the same road, vice Mr. J. R. Donnelly, transferred.

Mr. W. H. Elliott has been appointed engineer of signals of the New York Central & Hudson River Railroad, with headquarters at New York City, having jurisdiction over all divisions except over the electric zone.

Mr. O. M. Foster, formerly assistant master mechanic on the Lake Shore & Michigan Southern Railway, has been appointed master mechanic on the same road, with office at Elkhart, Ind., vice Mr. M. J. McCarthy, transferred.

Mr. G. A. Goodell, formerly general superintendent of the Chicago Great Western Railway at St. Paul, Minn., has been appointed general superintendent of the Northern Pacific, with headquarters at Livingston, Mont.

Mr. R. J. Cottrell, formerly charge hand on the Grand Trunk Railway at St. Thomas roundhouse, has been appointed locomotive foreman on the same road, with office at St. Thomas, Ont., vice Mr. W. H. Towner, transferred.

Mr. J. B. Jackson, formerly professor of electrical engineering at the Pennsylvania State College, has re-

cently been appointed by the Board of Trustees of that institution, to the position of Dean of the School of Engineering.

Mr. Charles J. Laing, formerly secretary to George H. Daniels, while the latter was general passenger agent ot the New York Central, has been appointed manager of the branch office of Waterman, Anthony & Co., New York City.

Mr. Joseph Quigley, formerly general foreman on the Cincinnati, New Orleans & Texas Pacific at Somerset, Ky., has been appointed master mechanic on the same road at Chattanooga, Tenn., vice Mr. T. O. Sechrist, transferred.

Mr. Wm. Wratten, formerly general foreman for the Chicago, Milwaukee & St. Paul Railway of their locomotive repair shops at Dubuque, Ia., has been appointed district master mechanic on the same road, with headquarters at Mobridge, South Dakota.

Mr. James L. Stark, for the past ten years connected with the mechanical department of the Cincinnati, Hamilton & Dayton, and previously with the Consolidated Rolling Stock Co., has been appointed general inspector of the car department of the Hocking Valley.

Mr. Hollis G. Rand, a locomotive and car building expert, has been selected to instruct New Haven engineers and trainmen in the mechanism of the New Atlantic and Pacific type engines recently received from the American Locomotive Co. Mr. Rand uses a car specially fitted up for this purpose.

Mr. Charles C. Rowell, locomotive engineer on the Chicago, St. Paul, Minneapolis & Omaha, in retiring from active service a short time ago, has closed a remarkable railroad record. Mr. Rowell entered railroad service in 1856, as fireman on the Northern New Hampshire. He handled the scoop for about three years, after which he was promoted to the "right hand side." After about a year at the throttle, he accepted a position as stationary engineer in Connecticut, but in another three years was back again at railroad work. In 1863 he went to Dayton, Ohio, and ran a train between that point and Sandusky. The year 1867 found him in the employ of the C., St. P., M. & O., as locomotive engineer, a position which he has held with credit to himself and with the unqualified confidence of the officers of the road for a period of forty years. During that time he has never been in a serious wreck and has carried with him, all through, the reputation of being a careful and competent engineman. He retired voluntarily after a half a century of hard work well done and with a record of which he may justly feel proud.

Lord Kelvin.

The death of Sir William Thompson, known as Lord Kelvin since 1892, removes another figure from that group of splendidly gifted scientific men who did their work in what has been called the Victorian era in the history of Great Britain. Lord Kelvin was the contemporary of Darwin, Huxley, Tyndall, Spencer and others who in the various departments of scientific work did so much to extend and widen the whole range of human knowledge.

Lord Kelvin had the ability, possessed by few, of not only being capable of carrying out original research, and of solving, in the laboratory, most complex problems, but he was able to apply the results of his labors in a practical way to the everyday needs of the work-a-day world around him. An example of how his knowledge of abstract truth was thus turned to account may be mentioned. He devised a deep sea sounding apparatus, by which the depth to which the lead sank was recorded in a glass tube which was carried into the depths with the sounding line. The tube was of small bore, open at the lower end and coated inside with a red powder. It was protected from injury by a case which allowed the water to enter. As the lead went down, water rose in the tube and compressed the air above it in the tube, and at the same time washed away the powder which lay along its interior. When the lead came on board again, the point to which the water had forced its way was easily perceivable and a measuring scale applied to the tube gave the depth. The scale had previously been calculated from the known diminution of volume of a gas under pressure and also from the knowledge of the increasing pressure of the water according to its distance below the surface. The tube thus registered the vertical depth to which the lead had sunk even if the sounding line had been carried far out of the perpendicular by an ocean current or the motion of the ship.

Lord Kelvin was essentially a broad-gauge man, theoretical and practical; he was also a mathematician of exceptional brilliance and he was a thorough master of electrical science. His connection with the laying of the submarine telegraph cable across the Atlantic was alone sufficient to place his name high on the honor roll of the world's greatest thinkers and workers, and his many other achievements in applied science have but added to his laurels. An interesting episode in his later life was his avowal at a public meeting of his firm belief in God at a time when other scientific men preferred to be classed among the agnostics or the doubters. He was closely in touch with modern scientific progress and at the advanced age of eighty-four, when the summons came, he had not given up interest or lost heart in the great and noble work of his life.

Good Pickling Tank.

One of the most novel features connected with the new locomotive shops of the New York, New Haven & Hartford Railroad which have recently been put in operation at Readville, Mass., just out of Boston, is the lye house. This very necessary part of the outfit of a railway repair shop is usually one of its most disagreeable features. In the shop plant above named, the pickling process has been robbed of nearly all its objectionable features, chiefly because its importance has been recognized to the extent of warranting its installation in a separate building conveniently arranged for the puropses which it is supposed to serve.

The arrangement of the plant is shown in our engraving. The building is 67 by 31 ft. 10 ins. Each vat is 18 ft. 8 ins. by 10 ft., and the greatest depth is 7 ft. The bottom slopes 4 ins. in 20 ft. The pits are made of concrete with walls 18 ins.

LYE VAT, N. Y., N. H. & H. RAILROAD, AT READVILLE, MASS.

and floor 9 ins. in thickness. The specifications for construction required that the interior should be waterproofed with a soft soap and alum solution, but it was found that when in use the grease from the parts which were put into it was absorbed by the walls to such an extent as to make ordinary water-proofing processes unnecessary. It is the usual practice to line tanks for this purpose with steel, but thus far the experience with the concrete tank seems to indicate that this is unnecessary.

On account of the ample room provided, most of the objectionable features of the lye tank are eliminated and the efficiency of the plant correspondingly increased. Each pit has a concrete platform sloping 4 ins. in 20 ft., covered by a grating of 3 by 6-in. yellow pine strips spaced 2 ins. apart on a frame of 4 by 4-in. spruce joists. All the rest of the floor is small broken stone generally called macadam.

Our New Locomotive Chart.

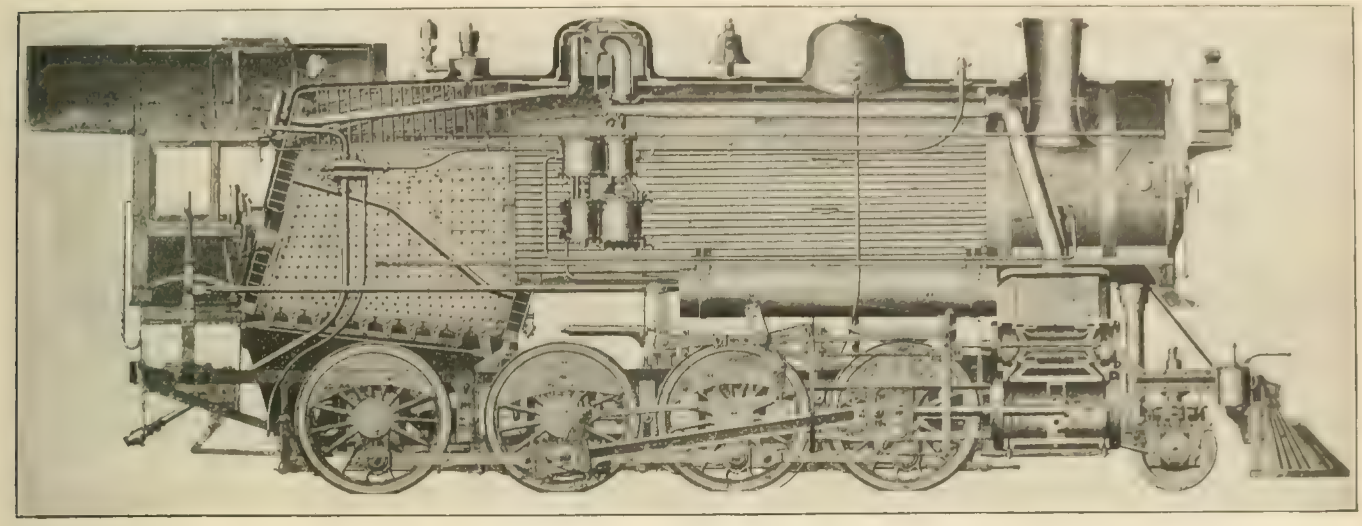
The new transparent chart with which RAILWAY AND LOCOMOTIVE ENGINEERING marks its twenty-first year of publication, is that of a consolidation or 2-8-0 engine. The locomotive selected as typical of this class was No. 631 on the Chesapeake & Ohio Railroad, of which road Mr. J. F. Walsh is superintendent of motive power. The engine has piston valves driven by the Walschaerts gear.

Two of these engines are in service at present and are very much liked by the men. Mr. Walsh has kindly given us some information concerning their performance. These engines are simple and have cylinders 22x30 ins. He says they handle 1,800 tons of freight on a grade of 21 ft. to the mile, 1,500 tons on a grade of 30 ft. to the mile and 700 tons on a grade of 60 ft. to the mile. The cost of running repairs is less than that of other consolidation engines on the road.

They carry a working steam pressure of 185 lbs. to the square inch and with 65 in. driving wheels have a calculated tractive effort of about 40,000 lbs. The coal consumption handling the trains is about 12 miles per ton. The coal used is very fine run of mine and averages about 80 per cent. of slack. About 225 gallons of water is consumed per mile run.

Mr. Walsh concludes by saying, "we have, on all classes of our engines, given the best possible attention to the convenient arrangement of cab fixtures, as it is our experience that an engine which is popular with the men who have to operate it is very likely to cause little trouble otherwise."

Our chart has been drawn to scale and is reduced to 25 inches in length, so that every detail is in proper proportion. Each part has been numbered and the name of each is given in the margin. There are in all such 303 names. This chart is the best that has been issued so far, considered both from an artistic and an engineering point of view. It is printed on specially prepared paper and orders for several thousand copies were on hand before publication. It seems to surpass in popular favor any of the numerous charts hitherto published in connection with RAILWAY AND LOCOMOTIVE ENGINEERING.



REDUCED FAC-SIMILE OF OUR NEW TRANSPARENT CHART.

HEAVY, SIMPLE CONSOLIDATION ENGINE ON THE CHESAPEAKE & OHIO RAILROAD.

The Car Wheel.

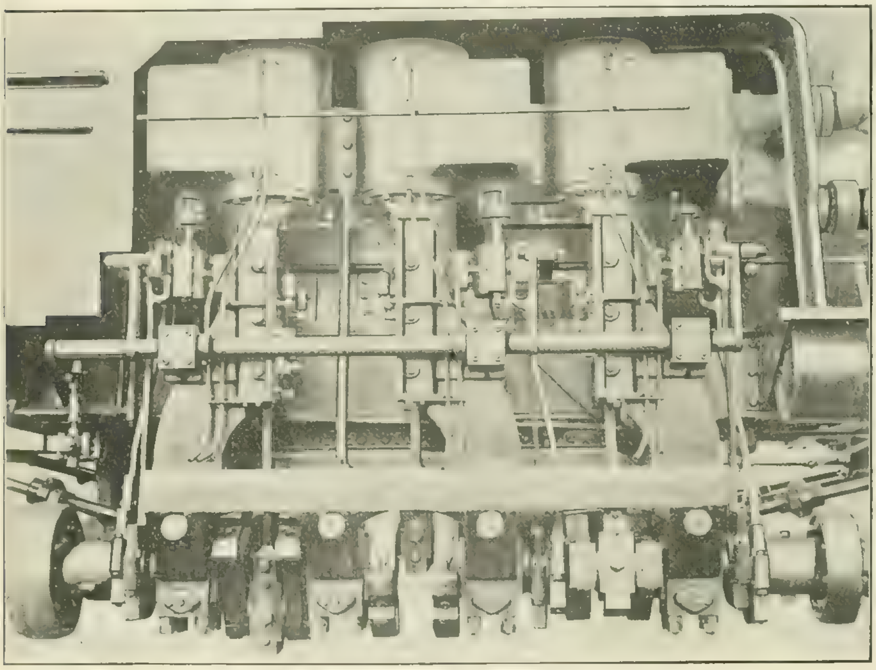
One of the most important books which we have seen, bears the title given above, and is the result of a series of investigations made by George L. Fowler, M. E., of New York. The book is published by the Schoen Steel Wheel Company, of Pittsburgh, Pa., and is copyrighted by that company. The investigations have been carried out with painstaking accuracy and the fullness of description which Mr. Fowler gives of his work leaves nothing to be desired. The Schoen Company are to be congratulated upon the collection of so much valuable data concerning cast iron and steel wheels as is here presented.

The work contains 160 pages and is beautifully and clearly illustrated. The chapters, for such they may be called, take up the Design of the solid forged and rolled steel car wheel. The comparative physical and chemical tests of steel wheels, tires and cast iron wheels. Micrographic records showing the penetration of work and character of heat treatment. The shelled-out wheel, a possible explanation of the causes of wheel and tire failures. Some areas of

contact between wheels of various diameters under loads, and the rail. Coefficients of friction between wheels and rails, tractive values, skidding and slipping. Lateral thrust of wheels against rails, breaking stresses of wheel flanges, and the presentation of the advantages claimed for the Schoen solid forged and rolled steel wheel as based on the investigations, together with the demonstration of service tests.

Want of space prevents extensive comment on the value of the work done; not only reading but diligent study is required to grasp the many new facts brought to light. The data concerning the friction between wheel and rail are most instructive, and as with a skidding wheel than with a spinning wheel With a spinning wheel there is no continuous deformation of the metal of the rail to be effected. In skidding there is a depression of the rail to be carried forward like a wave, which naturally raises the resistance and makes the coefficient greater than where slipping over one spot alone takes place.

"While it is not safe to draw rigid conclusions from the limited amount of data obtained, it does appear that inasmuch as the steel wheel offers greater resistance to spinning, it is better adapted for use as a driving wheel of an electric car than the cast iron wheel; and further its higher co



ENGINES OF THE SHAY GEARED LOCOMOTIVE.

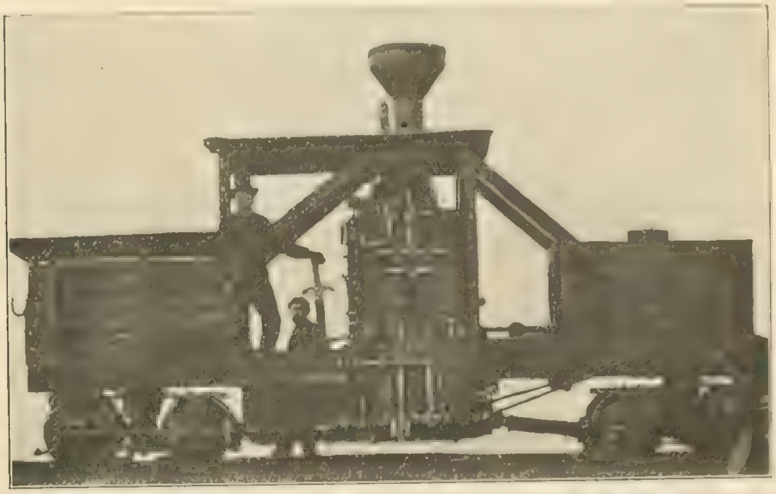
an example we may be permitted to quote as follows: "When the cast iron whel is loaded on the rail it indents the rail, in proportion to the pressure applied, without being distorted itself. If, then, it is turned, as by a motor, it simply revolves in the concave depression in the rail, without undergoing any deformation itself and with no resistance other than that of overcoming the friction between the surfaces of the wheel and rail. The steel wheel on the other hand, is itself compressed, as well as the rail, so that when it is turned a continuous progressive compression of the tread is set up equal to the amount of the original compression. Hence, the resistance to turning will be equal to the frictional resistance plus that set up by this compression."

Further on we read, "This depression of the rail, due to the imposition of the wheel load, accounts for the higher coefficient of friction obtained efficient of friction renders it less liable to skidding."

Geared Engines Built at Lima.

The Lima Locomotive and Machine Works are situated near the Erie railroad station in the town of Lima, Ohio, and are a fine example of a thoroughly modern equipped locomotive works. The main office, which is just completed, is an elegant structure of five stories, and besides the general offices contain the drawing rooms and headquarters of the mechanical engineer. The erecting shops are fitted with every variety of the best machine tools, and locomotives of the lighter kind, especially the Shay geared locomotive, are the principal output at the present time. The utility of the geared locomotive as manufactured at Lima is being rapidly demonstrated, especially in heavy traction work. The general type weighs 125 tons and with

180 to 200 pounds pressure would in any form make a powerful locomotive. The gearing of the locomotive more than doubles its hauling capacity. This peculiarity is accomplished by placing the cylinders, three in number, on the right side of the locomotive immediately in front of the cab. As will



EARLY FORM OF SHAY GEARED LOCOMOTIVE.

be seen in the accompanying illustrations the three engines are of the vertical kind and drive a shaft which runs the entire length of the wheel base of the locomotive and tank, and is connected with the driving wheels and also with the wheels of the tender trucks by bevelled spur gears of cast steel. The cylinders are attached to the boiler by heavy steel castings and are also slidably attached to the locomotive frames. The driving shaft works in slidable sockets, allowing ample swinging motion to the truck wheels.

The general type of gearing has 19 teeth on the shaft and 42 teeth on the locomotive driving wheels, thus giving a multiplying power equal to 2.2. The three cranks are set at different angles. each being 120 degs. apart. The whole structure is compact and elegant, and immediately under the eye of the engineer. It may be added that the superimposed weight on the right side of the locomotive is balanced by placing the boiler a sufficient distance toward the left side, in some cases amounting to 13 ins., according to the weight of the cylinders, rods, etc. This form has the advantage of allowing the engineer a fuller view of the track. Mr Thos. Nesmith, the clever and gentlemanly demonstrater at the works, stated that the extensive plant was already running to its full capacity and an increase in the size of the works in the near future was inevitable.

The Shay geared locomotive is certainly an interesting machine. All its wheels are used for traction, just as those of a switching engine usually are. In this connection it may not be out of place to give the rule for calculating the tractive effort of this kind of locomotive, and at the same time show how it is related to the usually employed formula for ordinary locomotive engines.

The formula for calculating the tractive power of a Shay locomotive as

THE SHAY GEARED LOCOMOTIVE. ALL WHEELS ARE DRIVERS.

given by the Lima Locomotive and Machine Company is as follows:

$$T = \frac{d^2 \times s \times 1.5 \times P \times G}{D \times p}$$

where d is the diameter of the cylinders, and s is the stroke, both in inches; P is the mean effective pressure, which the Lima people take as

75 per cent. of the boiler pressure. G is the number of teeth in the gear, and p the number in the pinion. The constant 1.5 is introduced because there are three cylinders used. The formula is similar to that for an ordinary simple engine with the exception of the constant 1.5, and the gear ratio. The Master Mechanics' Association use 85 per cent. of the boiler pressure as the mean effective pressure in the cylinders, but the Shay locomotive builders take 75 per cent. of the boiler pressure for the M. E. P.

In the formula for the tractive effort of an ordinary simple engine the constants for the number of cylinders and the number of strokes in one complete cycle, are also used, but they happen to cancel out, and, therefore, do not appear as separate figures in the rule. The ordinary tractive effort formula when written out in full, and as it is logically constructed, is, the area of the cylinder in inches, multiplied by the stroke, multiplied by two; for the forward and backward movement of the piston, multiplied by two; for the pair of cylinders on an ordinary locomotive, multiplied by the M. E. P. in pounds, taken as 85 per cent. of boiler pressure, divided by the circumference of the driving wheel in inches. In mathematical form the equation for the tractive effort, T, stands:

$$T = \frac{d^2 \times .7854 \times 2 \times S \times 2 \times P}{D \times 3.1416}$$

In this fraction the figures cancel out entirely and leave the letters, which simplifies the formula very considerably. In the formula for calculating the tractive power of the Shay engine the cancellation leaves the letters, including those for the gear ratio and the constant 1.5, to which we have referred, due to the presence of the three cylinders.

Gigantic Planer.

Probably the largest and heaviest metal working planer ever built has recently been shipped from the Philadelphia works of Niles-Bement-Pond Co. The total weight of the machine is 845,000 lbs., or 422½ tons. Four motors with a total capacity of 207½ h. p. are required to operate this remarkable tool.

The machine is, practically, an extremely large planer, but in addition to the movements found on a standard machine, many new ones have been added. Each head is fitted with a slotter bar independently driven by rack, giving a cutting speed that is practically constant from one end of the stroke to the other, and a quick return. Each head is arranged for transverse planing, having a planing movement across the bed which can be varied within desired limits, and having a quick return.

These movements for slotting and transverse planing make it necessary to throw out the regular driving mechanism to the table and connect it to a separate feed motion which, in this case, is entirely distinct from the regular feed motion. This throwing out of the driving mechanism, however, means simply that the pneumatic driving clutches are thrown into and left in their idle position.

The machine is fitted with its own air compressor and motor, thus making it independent of the air supply in the shop, to which, however, it can be connected if desired, and a complete switchboard is furnished for control of all the motors.

The distance between uprights is 14 ft. 4 ins.; the maximum distance from table to bottom of cross slide is 12 ft. 2 ins.; maximum stroke of table is 30 ft.; maximum stroke of slotter bar is 8 ft.; total width of bed, 13 ft.; length of bed, 60 ft.; table ways, 15 ft. each in width; tool slides, 7 ft. 8 ins., with 4 ft. vertical traverse; cross rail is long

LARGE PLANER IN COURSE OF ERECTION.

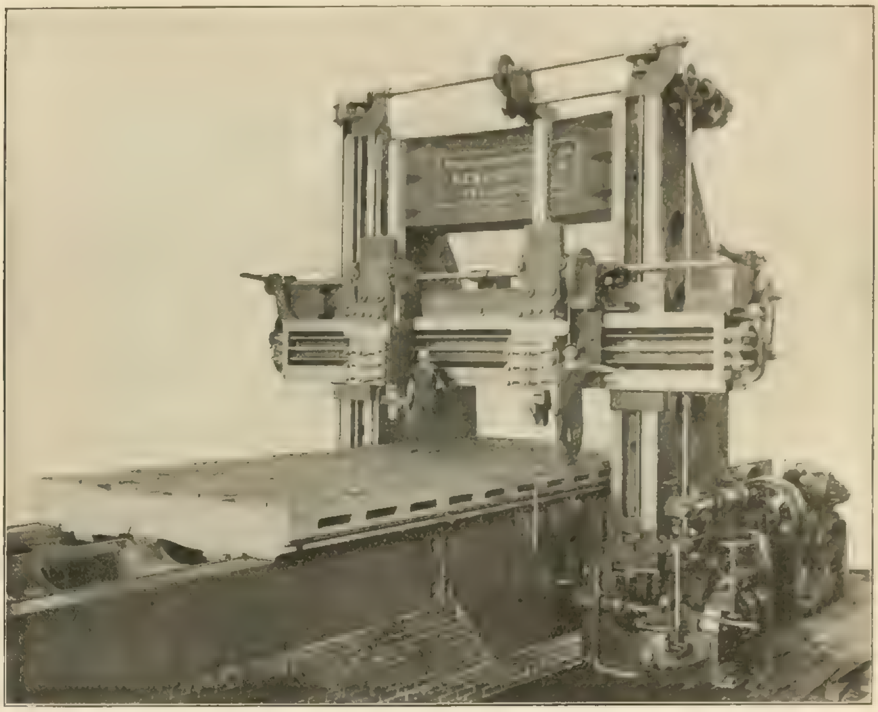
enough to admit full traverse of either head between the posts; face of uprights, 2 ft. 6 ins.; vertical height of cross slide, including the top rib bracing is 5 ft. The main driving motor is 100 h. p.; slotting and cross planing motor is 50 h. p.; lifting motor to cross slide, 20 h. p.; traverse motor for heads on cross slide, 7½ h. p.; air compressor motor, 30 h. p.

The cutting and return speeds are variable through the motor, which has a variation of from 1 to 1¼ and further range by change gears. The cutting speeds are 14 to 25 ft., and return speeds 52½ to 65½ ft. The same style of drive is used for slotter and gives a cutting speed of 18½ to 30 ft., and return speed of 57 to 71 ft. Cutting speed for cross planing is 11½ to 19 ft., and return speed 35 to 43½ ft. The cross traverse speed to the heads is 50 ins. a minute; the vertical speed for raising and lowering cross slide is 26 ins. a minute.

The main drive from the 100 h. p. motor is through the gearing to the pneumatic reversing clutches at the base of the upright. The speed of these clutches can be varied, as stated above, to some extent, by changing the speed of the motor, and a great variation obtained by the simple reversal of two change gears. The pneumatic clutches which are shown thoroughly incased are of the well-known N-B-P type with a large number of friction discs, whereby a great friction area is obtained in a comparatively small compass. These clutches, as their name implies, are operated by compressed air. A small valve, easily moved by hand, controls the stopping, starting and reversal of the table, and handles satisfactorily the power given out by the large driving motor.

Among the many other new features, not the least is the pneumatic feed. On the side of the upright just above the gearing is a cylinder with piston rod extending to the left. This rod carries a rack which meshes into a gear near the bottom of the vertical feed shaft, and this shaft, on its lower end, has a bevel gear meshing into a bevel gear on a horizontal shaft which transmits motion to the vertical feed shaft on the left hand upright. The movement of these feed shafts is constant at all times, and variation in amount and direction of head feeds is obtained by adjusting the connecting rod in the slotted cranks on the ends of the cross slide. These cranks are graduated in such a way that definite cross and vertical feeds can be obtained and by using at the same time the cranks on both sides, an angular feed can be given to the tool, which is at times desirable as the whole heads were not designed to swivel. The valve for controlling the air to the feed cylinder is thrown automatically at each end of the stroke, this movement being ing taken from either the main driving gear train to the table or the slotter gearing, when slotting is being done. To throw out the feed, it is simply necessary to close a valve, cutting off the air supply.

For the main drive, the power is carried through the upright into the bed, while for the slotter drive it is transmitted to the vertical square shaft and thence by bevels and spur gearing to the horizontal square shaft running along the top of the cross slide. The pinion on this shaft drives the large gear, and the rack pinion which gears into the back of the cutter bar is on the shaft with this gear. The pinion on the square shaft slides and can be thrown in or out of gear as desired, so that either or both bars can be used. The disc shown just above the motor controls the length of stroke. This disc is driven from the main train of slotter gearing and the adjustable stops on its periphery can be set at any desired point and effect the reversal in the same way as do dogs on the side of a planer table. Near the bottom of the square vertical shaft is the bevel gear on the end of a horizontal shaft which goes across the bed and which



LARGE PLANER BUILT BY THE NILES-BEMENT-POND COMPANY.

can be connected to the mechanism operating the valve of the feed cylinder on the opposite side.

The central section of the bed is divided longitudinally into three parts and the two end sections into two parts, or seven parts in all. The total weight of the bed is about 275,000 lbs. The table is made in two sections divided longitudinally in the center and weighs about 140,000 lbs.

The motor for fast traverse of heads is on the end of the cross slide. The reversing is done through friction clutches, and a safety is provided which prevents throwing in the fast traverse and the feed mechanism at the same time.

On the end of the table are shown finished pads over the V and flat ways. These are to carry the heads for truing up the ways when worn out of alignment. The method is as follows: The table is raised say ¼ in. above the ways and supported in this position on sliding blocks fitting the inner small auxiliary shears, which are used only for this purpose. The truing heads being fastened to the end of the table, the ways are trued up from the center to the end. The heads are then placed on the opposite end of the table and the remainder of the ways finished. Near the center of the bed there are pockets in the ways in which these same truing heads are placed, and the table is in its turn then planed up in the same manner.

The elevating screws for cross slide are firmly held top and bottom, and the nut in the cross slide sets into a shouldered end in square pocket. It is expected that this will take care of the slotter bar thrust satisfactorily, but if any loosening or trouble is experienced, arrangements have been made so that the slide can be firmly braced to the uprights.

Some splendid half-tone illustrations of famous Atlantic City's hotels, the board walk, piers and the Dixon graphite exhibit and figures made in the sand on the beach make the December *Graphite* a unique souvenir of Atlantic City, the Street Railway Convention and the Joseph Dixon Crucible Company. The December *Graphite* is interesting and its pages indicate the fact that the company keeps up-to-date with original convention exhibits and methods for making known the style and quality of Dixon's graphite products, which can be used in one form or another by almost every citizen in the world. Write to the Joseph Dixon Crucible Company, of Jersey City, N. J., if you would like a copy of their neat and interesting monthly periodical.

General Foremen's Convention.

The next convention of the International Railway General Foremen's Association will be held in Chicago, Ill., on May 25th to 29th, inclusive. The Lexington Hotel in that city has been decided upon as the headquarters of the association during the convention. It is expected this will be a very important meeting, as a number of interesting and instructive papers are in course of preparation. The president of the association is Mr. E. F. Fay, general foreman of the Union Pacific shops at Omaha. The secretary is Mr. L. H. Bryan, general foreman of the Duluth & Iron Range Railroad at Two Harbors, Minn. Mr. Bryan will be happy to reply to any inquiries concerning the association or about the forthcoming convention.

Catching Carp in the Salton Sea.

A story comes from the West to the effect that passengers on Southern Pacific trains are said to have had some rare sport trolling from car windows for fish in the Salton Sea, and now and then catches have been made. About midway on the sea an arroyo extends back into the mountains. The track crosses this on a trestle. The depth of the water varies from 15 to 25 ft. deep, and it has become the custom of the dining car porter to throw the scraps from the table overboard somewhere along this trestle. A great many fish of all sizes lie in wait for the train and can be easily seen.

Some time ago an irrepressible fisherman baited his hook and threw out his line, and as the train slowly passed over the long trestle he swung it far out over the water. A hungry fish mistook this for the customary meal, and soon a carp, three feet long, was drawn aboard. It is not reported whether any of the passengers threw a time table overboard so that the fish could keep track of the flyers and not have to hang round the trestle doing nothing between trains.

The Romance of Carborundum.

There is a well known saying that "the man who makes two blades of grass grow where only one blade grew before is a benefactor to mankind." How much greater must be the services of a man who discovers or invents a new material which performs functions previously impracticable and creates a new industry that promises to give attractive employment to thousands of persons?

This was the achievement of the man who discovered carborundum, and the story of his work is admirably told by F. W. Haskell in a pamphlet entitled, "The Man Who Didn't Know When He

Had Failed." This pamphleteer has, by the way, extraordinary versatility as a graphic writer, and carries the reader into laboratories and workshops that become fairyland under his magic touch. He tells us that

"Some fifteen years ago in a little town in Western Pennsylvania, a man—his name was Edward Goodrich Acheson—was carrying on a series of experiments with the use of an electric current. In one of these experiments he produced some little, almost microscopic, crystals which sparkled like diamonds. He found that these crystals were so hard that they would cut glass. He produced more of them, and by making some changes in his methods found that he could make them in considerable quantities. * * *

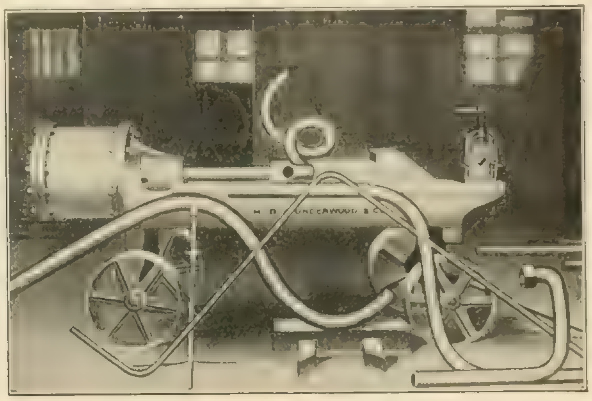
"The new substance was beautiful in appearance, but the vital question was, Is it good for anything? A study of its properties showed that it was intensely hard, intensely sharp, and infusible at any known heat. These properties suggested that it was peculiarly adapted for abrasive or grinding purposes, and as a highly refractory material."

This material, which was given the name "Carborundum," was first used for gem grinding and cutting and was sold for 40 cents a karat or $880 a pound. Improved methods of production cheapened the product until it could be used economically for all kinds of grinding purposes, and became useful for many mechanical purposes. We have not room for details of the story, but we recommend people who wish to read the whole of the industrial romance to apply to the Carborundum Company, Niagara Falls, for a copy of the pamphlet.

The Collin pressure regulating valve is described and illustrated in a catalogue got out by the Ohio Brass Company of Mansfield, Ohio. The principle of its operation is such that the valve cushions on closing and is balanced when open. The bodies of the main and of the controlling valve are made of government standard composition as used by the United States navy. The other parts are made of heavy steam bronze. The springs are high grade steel nickel plated. The valves are tested up to 350 lbs. per sq. in. The whole valve is so designed that it may be easily taken apart and all its parts are thus readily accessible for renewal or repair. The catalogue is excellently illustrated with half-tone engravings and the letterpress is full and complete. The Ohio Brass Co. will be happy to send a copy to anyone interested enough to apply to them direct.

Pipe Bending Machine.

Our illustration shows a new pneumatic pipe bending machine which fills a want long felt by many who have pipe bending to do, and have been compelled to do it by hand machine, and by filling and heating. This machine has been in practical use for a number of months in a large railroad repair shop and has been used in doing all the pipe bending required in equipping locomotives, together with all air brake and regular pipe work in the shop. It will make a right angle bend in a 2 in. pipe in two minutes. It does not flatten or injure the pipe in any way. Dies of standard radius for locomotive work for ½ in. up to 2 in. pipe are supplied, and special dies of any required radius or shape are made to order by the makers. The machine is being manufactured and placed on the market by the well known firm of H. B. Underwood & Co. of Philadelphia, Pa., who have been making a line of portable tools for many years. Their tools have become standard in a large number of the best shops, and this pipe bender is a valuable addition to their already numerous high grade tools.



PORTABLE, AIR OPERATED PIPE BENDING MACHINE.

It is only by labor that thought can be made healthy, and only by thought that labor can be made happy; and the two cannot be separated with impunity. —*Ruskin.*

Types of Compound Locomotives.

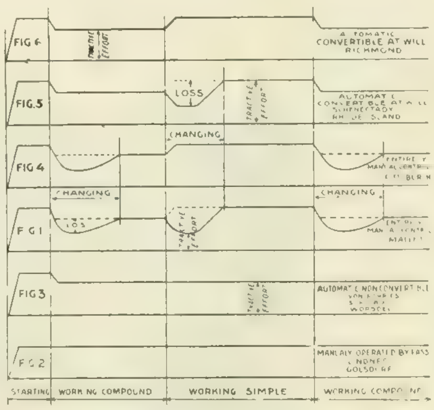
In what follows I have endeavored to give a general idea of the action of those compounds most commonly used, which are, for cross compounds, the Mallet, Lindner, Golsdorff, Von Borries, Schicau and Worsdell in Europe, and Rhode Island, Pittsburgh, Richmond and Schenectady in the United States.

The Mallet Compound is a convertible, manually operated, change and starting mechanism that supplies live steam to the L. P. cylinder when and only when the H. P. cylinder exhausts to the atmosphere. At the change from compound to simple, the L. P. steam chest pressure is greatly reduced in advance of the admission of live steam, making the engine partially lame on the L. P. side until pressure is re-established by live steam. A still longer period of lameness takes place in changing from simple to compound, as the change again empties the L. P. steam chest and the pressure is only restored by accumulation of exhaust steam from the H. P. cylinder, which for several revolutions has to do the work practically one sided. This is shown graphically in diagram Fig. 1. It may be remarked that the name Mallet compound, applied to the articulated compound engine, as built by the American Locomotive Company, is incorrect, as it is only Mallet principle of articulation that is followed, which may be called the pony truck principle, instead of the swivelling, as is generally followed by most designers of articulated engines.

The de Glehn engine is of the four cylinder balanced type and has been given his name because he took up the subject for actual service. His first attempt was to do away with side rods, and it has been argued that his engine was limited to that kind of construction, that is, the L. P. cylinders working on the front axle inside the frame, and the H. P. cylinders driving on the rear axle. The subject of four cylinder compounds was taken up by various roads and shops in France, Germany and Switzerland about the same time, but all applied the side rods, including M. de Glehn himself, in his later designs, and Mr. Henry, chief engineer of the Paris, Lyons & Mediterranean Railway, claims the honor of having introduced the four cylinder compound with side rods, but this claim appears not to have been recognized by other roads or builders, and neither one nor the other of these inventors are recognized in Germany or Switzerland, in which countries other workers claim that they had been planning the four cylinder balanced compound entirely independent of and even before M. de Glehn.

The Lindner and Golsdorff compounds consist simply of arrangement for letting live steam into the receiver and L. P. steam chest. The former by means of an ordinary cock or valve turned by hand, and the latter by linking down the engine to excessive valve travel when the L. P. valve uncovers a live steam passage in the valve seat. In both of these cases the live steam backs up against the H. P. piston with the same pressure as that on the driving side of the L. P. piston, thus the engine is losing power on the H. P. and gaining on the L. P. side. It amounts practically only to getting steam for L. P. cylinder in starting if the H. P. crank pin is on the center, and produces no gain in power without an unequal distribution of the work in both cylinders, as is apparent in diagram Fig. 2.

Von Borries, Schicaus and Wordsell's intercepting valve admits steam automatically to L. P. cylinder in starting, but prevents this steam from backing up against the H. P. piston by the intercepting valve, which gives a greater and more uniform initial starting power than those of Lindner and Golsdorff. The engines are not convertible into simple, and the apparatus exerts no other function than admitting steam to the L. P. cylinder for the first revolution in starting. See diagram, Fig. 3.



GRAPHIC REPRESENTATION OF PRESSURE AT THE MOMENT OF CHANGE.

The Pittsburgh engine is the same as the Mallet, a non-automatic, convertible compound, and empties the L. P. steam chest in changing from simple to compound, whereby the L. P. cylinder becomes lame for several revolutions, until the receiver pressure is restored to normal, which progresses gradually by gains of H. P. exhaust over that removed by the L. P. cylinder, stroke by stroke. These conditions are illustrated in diagram Fig. 4.

The Rhode Island compound is automatic in starting and convertible into simple by means of letting live steam into a chamber above the intercepting

valve and relieves pressure from the H. P. exhaust valve. This, however, opens the exhaust to the receiver and L. P. steam chest in advance of the supply of live steam to the L. P. cylinder in changing the engine to simple, whereby a loss is entailed in the same way as this change is made in the Mallet compound. This is shown in Fig. 5.

The Richmond has an automatic starting and compounding device, convertible into simple engine at will by the operation of an H. P. exhaust (emergency) valve only, affecting the pressure in an exhaust chamber separated, except by small vents, from the receiver by the extension of a piston on the stem of the intercepting valve when in compound position. In changing to simple, this chamber is exhausted, whereby the intercepting valve becomes unbalanced, closes, and cuts off the L. P. steam chest from the receiver before or at the moment the exhaust of the latter takes place, and at the same moment live steam, at reduced pressure, is admitted to the L. P. steam chest. In changing to compound the H. P. exhaust valve is closed, whereby

FRENCH WIND SPLITTER.

the exhaust pressure accumulates in the exhaust chamber and receiver, and at a predetermined pressure it opens the intercepting valve, whereby the live steam is shut off from the L. P. steam chest and the engine is in complete compound working. Thus it is seen that in this system there is no drop in the pressure at the change either into simple or into compound working of the engine, and a temporary increase in power of 20 per cent. can be had without risk of stalling under the change, however slow the speed, and how often it may be required to change on a grade, as is indicated in Fig. 6.

The Schenectady compound of 1896 operates in all respects similar to the Richmond, but it is not provided with exhausting balance chamber and must, therefore, in the same manner as Rhode Island, empty the receiver befor the change into simple engine can take place, and if the speed is slow there is a great risk of stalling under the change, which, therefore, must be made early on a grade, and retained until the summit is reached, with a reduction in the economy of the compound engine, the effect of which is shown in Fig. 5.

As a general thing it may be said that on a division with long grades, most of the saving gained on the level will be consumed if an engine is working simple all the way on the grade in order not to run the risk of stalling, whereas with the risk removed, nine out of ten times the engine would have taken the train over the grade working compound, and in the tenth case the simpling feature needs to be resorted to only in spots.

The non-convertible engines must always have a power margin left in load rating for spare power on the grades, that can be wiped out with a convertible engine, which, therefore, if reliable, must show a greater economy than any of the other types. All their characteristics are illustrated in the diagrams with reference numbers for each individual type.

In this connection it may be pointed out that the American Locomotive Co.'s articulated engine is a convertible compound on the Richmond system, with a tractive power diagram according to Fig. 6. The Mallet articulated compound corresponds to diagram Fig. 1. M. E.

The Philip Carey Company of Cincinnati, Ohio, have issued a fine catalogue of 70 pages showing the Carey Coverings for steam pipes, boilers and other heated appliances where the exposed surfaces naturally lose heat by coming in contact with cooler elements. The use of asbestos, magnesia, and other substances has met the requirements of the situation in an eminent degree and the Carey Company make a combination of the two substances which forms a good heat insulator, the asbestos fibre acting as a binder and holding the magnesia in form on the same principle that hair is used on ordinary plaster. The catalogue describes the various ratios of the mixture of the component parts to meet different degrees of heats and also a full description of other coverings used in low pressure steam and hot water pipes. It should be noted that the enterprising company have also made a specialty of furnace and stove lining cement. Braided tubing, wick packing and every form of gaskets are also included in their output. They will be happy to send their catalogue to any address, upon application being made to them.

For a man to conquer himself is the first and noblest of all victories, whereas to be vanquished by himself is the basest and most shameful of all things. For such expressions show there is war in each of us against ourselves.—*Plato.*

Intercolonial Motor Car.

The Intercolonial Railway of Canada have recently put in service a suburban motor car which has given very satisfactory results. Mr. G. R. Joughins, superintendent of motive power, has kindly furnished us with some details.

The car has seats for forty passengers, including eight in a smoking compartment. A baggage room seven feet long is also provided. At the forward end is a compartment seven feet long, which contains the steam generator, control levers and all accessory apparatus. The rear end is vestibuled. The car is handsomely finished in hardwood and the seats are upholstered in leather; it is heated by steam and lighted by acetyline. The outside of the car is of steel and presents a very handsome appearance.

STEAM MOTOR CAR ON THE INTERCOLONIAL RAILWAY.

The car is propelled by a 120 horsepower steam motor, which is mounted on the forward truck of the car and which drives on the rear axle thereof. This motor is of the Ganz inclosed type, and all parts are free from external influences. The working parts operate in an oil bath, thus insuring continuous and perfect lubrication.

MONCTON, N. B., STATION ON THE INTERCOLONIAL.

The steam generator is mounted in the motorman's compartment. It is of light and compact construction, 42 ins. in diameter and about 4 ft. high. The design is such that all parts in contact with fire and water can be quickly exposed for cleaning and repairs.

On a recent trial trip, a distance of 75 miles was run at an average speed of 34.7 miles per hour; 925 lbs. of coal was consumed, which gives an average of 12.33 lbs. per mile run.

We have recently received a folder from the Flannery Bolt Company of Pittsburgh, Pa., which among other things shows a ferocious bull-dog examining a Tate flexible staybolt. There is nothing particularly wonderful about that except that the animal is saying somewhat dogmatically "It looks good to me." He cannot eat the iron or even bolt the stay, but he seems to admire the staying quality of the bolt, which in that respect resembles his own strongest characteristic. Where others break it doggedly hangs on. The Tate flexible staybolt, we are told, is in use on more than a hundred railroads. This style of bolt has been used with satisfaction all over a firebox, but its best service is in the parts of the box where ordinary staybolts generally break. The Tate bolt combines the holding power of the ordinary stay together with a certain flexibility which is all its own. It is screwed into the inner firebox sheet and its rounded head fits into a cup-shaped nipple or plug which is screwed into the outer sheet, and a cap on the outside completes the job. Write to the Flannery Bolt Co. if you are in need of information regarding the flexible staybolt. Their office is in the Frick Building in Pittsburgh.

Locomotive Suffers Defeat.

When the Union Pacific was being built newspaper stories of the sad fate of Indians who interfered with the locomotive were in order. One of these stories was to the effect that a remorseless brave set out on a bucking broncho to lasso a full sized U. P. express. He threw his lariat well, and got hold of the smoke stack, and pony and man firmly braced themselves for the shock, but the train kept on going. At the end of the run the engineer disentangled a lot of rope from the stack with only the scalp lock and head feath-

ers of the remorseless brave at the loose end.

We have often heard of a wild bull charging the steam locomotive at a headlong rush and then going over the neighboring fence in a gracefully formed but wide and high parabolic curve and landing somewhere in the middle of next week resolved to give up the unequal struggle. We now quote a story which shows that the "touch downs" are not always on the side of the locomotive, and that for once a brave and determined elephant has actually made a goal. Here is what *The Railway Times* of Bombay (12th Oct., '07) says concerning the way they do it in India:

"On the morning of the 23d instant an elephant, said to belong to the Sub-divisional Officer Alipur Duar, was driven to the Terrai forests to fetch fodder. The beast was crossing the railway line somewhere up near Alipur Duar station when a down ballast train in motion tried to whistle him off the line. He obeyed the whistle, but instantly was on the line again and pushed the engine back with all the strength he could muster, causing the derailment of the engine and one of the trucks. The driver fell off and received some injuries, and the mahaut, who had apparently lost all hold over the animal and had perhaps anticipated the accident, jumped down but was unhurt. The elephant was only bruised."

There is no knowing what kindness can accomplish, and if these men had treated the elephant half decently he might have been induced to wait a few minutes and put the engine on the track again, while they fixed up the truck.

A profusely illustrated catalogue of over 300 pages has just been issued by the Newton Machine Tool Works Company of Philadelphia. The extensive works of this company, which are constantly expanding to meet the growing requirements, are the best proof of the popular favor with which their fine machines are being received all over the world. These machines embrace every variety of form and include horizontal milling machines, boring, drilling, saw cutting, planing, shaping and slotting machines. Among the newest forms are the rotary planing machine which, mounted on a circular sub-base, gives a degree of flexibility of action hitherto unapproached. The duplex rotary form of planer is finely adapted to the modern exacting requirements in cutting lengths of beams or other work. In the important department of cold saw cutting-off machines the fine material used has made it possible to cut the largest bodies of metal at a speed of nearly one inch per minute. The [illegible] machines fill a need that has grown to a sharp necessity and must be seen to be appreciated. Slotting machines are in every imaginable form and for every use from the ponderous armor plate slotting machine to the light [illegible] machine that can be placed [illegible]. The varieties of drilling, boring and milling machines are [illegible]. On the double spindle boring machines there are several new forms adapted to [illegible] a variety of work which a perusal of the catalogue fully explains. Copies may be had by those interested by applying to the company's office, Twenty-fourth and Vine streets, Philadelphia.

Evolution of a Steel Wheel.

Few of us ever stop to consider that the great law of evolution which we are inclined to think belongs only to the science of organic nature, yet follows us so closely that concerning those things which we know how to make we are as completely under its sway as is the life history of plant or animal. It is only stating a truism when we say that there are progressive stages in the formation

ARRIVAL OF THE SIMPLON EXPRESS.

of anything which mankind can make, and solid forged and rolled steel wheels are no exception to the rule.

Evolution is really an unfolding, and the various operations by which a finished steel wheel grows from a cast ingot is a case in point. The steel wheels of which we are speaking are made from what is known as an open hearth, high carbon steel, containing, as it is sometimes called, "point six-five to point seven-five carbon."

At the outset a cast ingot of open hearth steel is taken and is heated and rolled into a slab with a cross section of about 5x29 ins., and the porous portion containing what are known as "pipes" and segregated matter is cut off. The slab is cut into squares, and from each square so cut a solid forged and rolled steel wheel will eventually come. The slab may not inappropriately be called the raw material of the wheel, although there has been more work put upon the metal up to this point than is usually given to a steel tire, and from this point on the particular processes used by the Schoen Steel Wheel

Company, of Pittsburgh, Pa., leads up to and constitutes the visible evolution of the wheel, where hub and web and tire are all of one piece.

The first operation consists in shearing and squeezing the flat square slab in hydraulic presses capable of producing a pressure of 7,000 tons. The press shears the hot rough square slab into a circular disc just as a chef cuts out a circular cake from a flat layer of dough by means of a clean metal ring. At the same time, however, this hydraulic chef puts a central depression on each side of the steel cake by means of two acorn-like projections placed one in the upper and one in the lower die.

The next operation is carried on by a press exerting somewhat less pressure than the first, which, when applied to the re-heated cake, flattens the hub faces, punches out the metal between the acorn-like depressions in the center for the axle, forms the web and raises an embryo flange on the newly made rim.

Hitherto the growing wheel has been subjected to heavy hydraulic pressure, but the third operation introduces it to the rolling machine. Here the again-heated wheel has the outer portion of the web heavily rolled, the rim takes shape and the flange and tread assume the exact proportions of the M. C. B. standard. To do all this the wheel is revolved by powerful rolls, while side rollers applied to the web increase the diameter of the wheel; the rim rolls compress the rim to the required dimensions as it forms, and the contour of the tread is given by a specially designed roll made to suit the specification of the purchasing company. All rolling is under heavy pressure which, while it produces a highly compact metal, gives to it the required shape, and it leaves this machine as a finished product.

The final operation consists of "dishing" the wheel. It is placed under a 1,000-ton hydraulic press which grips flange and rim in its heavy jaws. While tightly held, and with outside rim up, the web is pressed down for a distance equal to the requisite dish of the wheel, and in so doing the hub is accurately centered and the wheel is made perfectly round, thus overcoming any slight inaccuracy which might have been caused in the process of rolling. The web is thus stretched a little, the rim and tread are again compressed and the machine delivers a solid forged and rolled steel wheel, awaiting only the hub boring and facing machine.

Throughout all these evolutionary processes the formers have compressed the hub, and rim, and tread, and by pressing, rolling and dishing have made the cake of hot metal into a wheel with three inches greater diameter than it had in the rough. The wheel when made is allowed to cool gradually, and after the hub, tread and flange have been machined it goes into service with hub, web, rim and tread all of one well worked piece of metal, there are no parts to work loose and nothing to break.

The makers claim that the wheel being all one piece may have its tire turned as often as need be, and when the wheel having made its total mileage is at last scrapped, it will, being a low phosphorus steel, bring a good market price. The wheels are said to give a mileage between 200,000 and 350,000 miles. Thus has the evolution of the Schoen steel wheel been made apparent and a few of the maker's claims stated.

Strength of Structural Timber.

Recent tests by the Forest Service of the U. S. Government show longleaf pine to be the strongest and stiffest of all the timbers named, with Douglas fir a close second; while western hemlock, loblolly pine, tamarack, and Norway pine follow in the order given. Douglas fir and western hemlock, of which there are comparatively large supplies, have high structural merit, as has also loblolly pine. Much of the information hitherto available concerning the strength of timber has been secured from tests of small pieces without defects. This can not safely be assumed to hold good for large-sized timbers as found on the market, since these commonly contain such defects as checks, knots, cross grain, etc. The proportion of heart and sap wood, and the state of seasoning, must also be considered. Circular 115 of the Forest Service, just issued, gives the results of tests that have been conducted during the past four years at timber-testing laboratories in different parts of the country. This circular will be mailed upon application to The Forester, Forest Service, Washington, D. C.

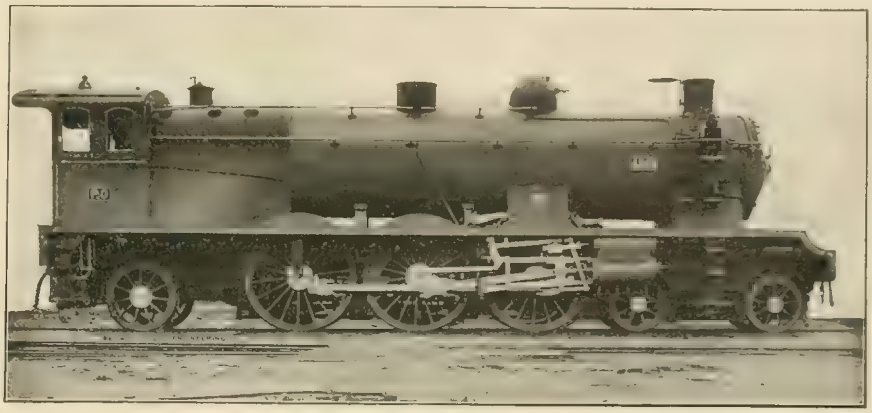
Circular No. 2 has been issued by the Pittsburg Pneumatic Company illustrating their drills, yoke riveters, chipping hammers and special devices. The fine implements manufactured by this company have taken their place at once in the front rank of mechanical tools. Several improvements have been developed, especially the long stroke riveting hammer, which has increased the force of the hammer blows while reducing the vibration to a minimum by the adoption of an air cushion. It may be noted that the air hammer as manufactured by the company has the peculiarity of taking air during the first quarter of the stroke only, the air being used expansively just as steam is used in the cylinder when the valve travel is shortened. The result is a large saving. Of the yoke riveters it may be said that they are readily adaptable to any kind of work. Copies of the circular may be had at the offices in the

West Street Building, New York, or the Fidelity Building, Pittsburgh, Pa.

4-6-2 for the Paris-Orleans Railway.

In our illustration is shown the first 4-6-2 express locomotive built for service on a European main line, though it will not long occupy its unique position, as this is only one of a number now in course of construction at the Belfort works of the Societe Alsacienne de Constructions Mechaniques, for the same railway. There are, in fact, fifty "Pacific" type engines of four different patterns, all, however, being four-cylinder DeGlehn compounds, on order at Belfort for French and German railways, those for the Fatherland being equipped with Schmidt superheaters, and three Pacifics built by Maffei, of Munich, will shortly be at work on the Baden State system.

For the present, however, the P.-O. engine shown is the largest and heaviest passenger locomotive in Europe, as the following dimensions will show:



4-6-2 EXPRESS ENGINE FOR THE PARIS-ORLEANS RAILWAY.

H. P. cylinders, diam. 15⅛ ins., stroke 25½ ins.; l. p. cylinders, diam. 25¼ ins., stroke 25½ ins.; diam. of wheels, bogie 3 ft. 1¾ ins.; coupled drivers 6 ft. ¾ in., trailing 3 ft. 9¼ ins.; wheel base, bogie 7 ft. 6⅝ ins., coupled 12 ft. 9½ ins., total 34 ft. 5¼ ins.; boiler, diam. of barrel 5 ft. 6¼ ins., working pressure 227 lbs. per sq. in.; height of centre above rails 9 ft. 3¼ ins., containing 261 tubes 19 ft. 4¼ ins. long by 2 ins. diam.; heating surface, firebox 165.44 sq. ft., tubes 2,603.62 sq. ft., total 2,769.06 sq. ft.; grate area, 46 sq. ft. The total weight of the engine in working order is 89 tons, of which 53 tons are on the driving wheels, and about 21 tons on the bogie wheels. The usual continental revolution counter is attached by a short rod to the crank pin of the rear drivers.

An interesting comparison of this engine and a somewhat similar one for the same railway, built at the Baldwin Locomotive Works, may be made by referring to our illustration and description given on page 397 of the September, 1907, issue.

Dudgeon's Hydraulic Jack.

The publication of an elegant new catalogue illustrating the hydraulic jack as manufactured by R. Dudgeon, New York, recalls the original invention of the lifting apparatus operated by the pressure of a liquid under the action of a force pump. Mr. Dudgeon was working as a machinist on a Southern road over fifty years ago when screw jacks were used in hoisting locomotives and other heavy material. Mr. Dudgeon was tired of the jack screw and, knowing something of hydrostatics, he conceived the idea of the hydraulic jack. The difficulties of introducing even the most meritorious invention were much greater at that time than they are to-day. Mr. Dudgeon's visit to Europe is a fine illustration. After securing his British patents he discovered that the hydraulic jack was being manufactured by a firm of whom he knew nothing. At that time Mr. Dudgeon could not afford to engage in prolonged legal controversies and so he returned to America. Fortunes have been made from his invention, and while he was yet a struggling mechanic his invention was used in moving the Great Eastern, the launching of which ship seemed in those days to be a mechanical impossibility, but which became comparatively easy with the use of Mr. Dudgeon's invention. It is gratifying to know that the New York firm has not only upheld the early reputation in the manufacture of Mr. Dudgeon's masterly invention, but that several important improvements have been made to meet the constantly increasing needs of the time, all of which are fully explained in the admirable new catalogue, copies of which may be had on application to the manufacturers, Broome and Columbia streets, New York.

The best thing to give to your enemy is forgiveness; to your opponent, tolerance; to your child, a good example; to your father, deference; to your mother, conduct that will make her proud of you.—*Anon.*

Use of Dead Timber.

The Forestry Department of the United States government have issued an interesting little circular, No. 113, on the use of dead timber. The writer, who is Mr. E. R. Hodson, forest assistant, says that sound dead timber is valuable, and though widely used in some localities is regarded as not worth using in others. Ignorance of the value of dead timber is said to be the cause of its rejection by many. Dead timber is either fire-killed, insect-killed, or is dead by reason of drying out or having been struck by lightning. Fire-killed timber is the best of the three classes, and it has the advantage of being perfectly seasoned. Speaking of the strength and the uses of fire-killed timber he says:

"In many places it is the popular opinion that dead timber is very much weaker than seasoned green timber. It is even held that timber which has been dead a number of years is weaker than green timber, and that the longer it stands the weaker it becomes. These views are quite wrong. By actual test it has been shown that sound timber, as a matter of fact, is almost as strong as seasoned green timber and much stronger than green timber before seasoning.

"Since the principal defect of dead timber is check, it has been used largely in the round for mine timbers, coal props, telephone poles, railroad ties, and fence posts. The better grades are also used for dimension stock, which is not seriously affected by the shallow checks found in these grades. It is not much used for inch stuff, however, except as cut-up stock, because of frequent cross checks.

"The chief use to which dead timber is now put is for mine timbers. For this purpose it is even better suited than green timber, because it is perfectly seasoned and is light." A copy of this circular may be had on application to the Department of Agriculture, Washington, D. C.

W. H. Nicholson & Co., manufacturers of machinery specialties, Wilkes-Barre, Pa., have issued an artistic catalogue showing their expanding mandrels and illustrating the various uses to which they may be profitably put. The eccentric-turning expanding mandrel for locomotive eccentrics is undoubtedly one of the most important additions to the fine tools that have come into use in recent years. It is rapidly coming into favor, and all who are interested should secure a copy of this fine catalogue and become familiar with the advantageous peculiarities of the Nicholson mandrels.

How to get more heat with less coal is explained in an H. W. Johns-Manville folder dealing with their covering for house and office building furnaces. Asbestocel is the name they give to a corrugated fireproof paper with which a heating furnace may be easily covered.

Another folder gives information concerning a fireproof material called asbestos building felts, sheathings, and roll mill board. This is adapted for lining sidewalks, floors and wood partitions. Asbestos sheet mill board is good for packings, fire screens, lining for ranges, stoves, grates and gas backs as well as for lining of floors, partitions, etc.

A third folder describes asbestos stove lining and is a substitute for fire brick in stoves, ranges and heaters, also for lining doors of boilers, furnaces, bridge-walls, etc.

Still another folder shows the J.-M. asbestos lead joint runner. It is made of pure asbestos rope of square cross section having a ferule on each end and provided with a clamping device for fastening it in place on a pipe.

This company also makes the J.-M. insulated arc lamp hanger and high potential strain insulator as well as the "No-arc" fuse plugs. The screw shell and fuse ferule are drawn from one piece of brass, there are thus no joints to work loose. These electrical appliances are described in a couple of folders and you can have any or all of the folders enumerated above, by applying to the W. H. Johns-Manville Company, of 100 William street, New York.

Kindness is catching, and if you go around with a thoroughly developed case, your neighbors will be sure to get it.—*Herald.*

CONTENTS.

Railway and Locomotive Engineering

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A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXI. 136 Liberty Street, New York, February, 1908 No. 2

The Continental Limited.

The Continental Limited or No. 1 on the Boston & Maine Railroad is one of the best and fastest trains on that line. It leaves Portland, Me., daily at 8:50 A. M., and runs to Boston, but the train proper starts from the Hub and makes connection with the West Shore Railroad at Rotterdam Jct., N. Y., for the Western cities of Chicago, Cincinnati and St. Louis. The equipment of the train consists of baggage and express car, day coaches, tourist cars, Pullman sleepers and dining cars. It runs over the Fitchburg division and the scenery along the line is famous in many lands. The train is hauled by the largest type of engines owned by the B. & M., and the road follows the valleys of the Miller's and the Deerfield rivers.

The Continental Limited leaves Boston at 12:30 A. M., and makes the run to Rotterdam Jct. in 6 hours and 55 minutes. The distance is 212 miles and the average speed is therefore about $30\frac{3}{4}$ miles an hour. The train, however, makes thirteen stops in that distance, so that the actual speed between stations is considerably above this.

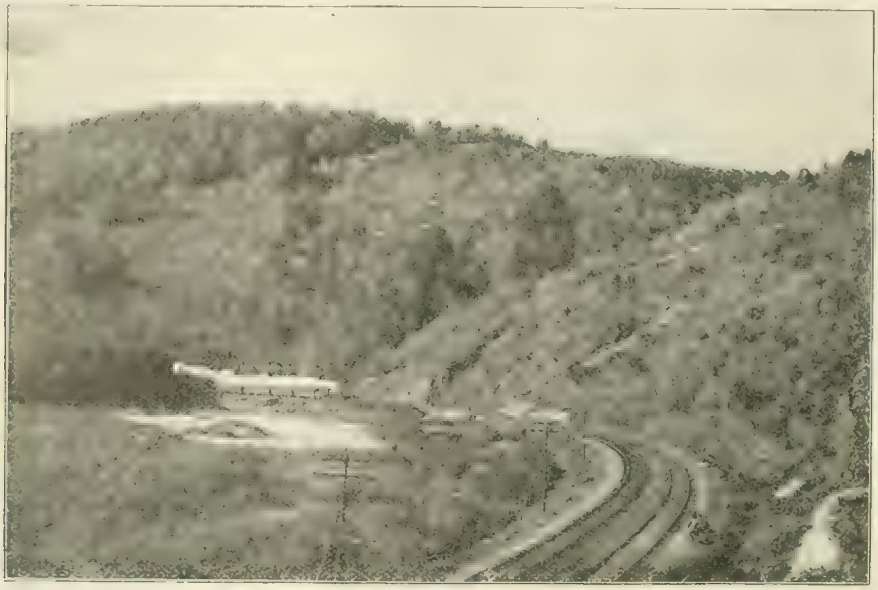
One of the most striking as well as the most famous natural feature of this route is the Hoosac mountain and the railroad tunnel which pierces it. Hoosac is from a word used by the Mohican tribe of Indians. It means mountain of rock. The history of the

THE CONTINENTAL LIMITED ON THE BOSTON & MAINE

tunnel is interesting. The inception of the idea dates back to 1855, when the Massachusetts legislature granted the Troy and Greenfield Railway a couple of million dollars for the construction of the tunnel. Misunderstandings and law suits delayed the work. In 1863 the State undertook the work, which was carried on slowly and tediously. After five years' work only 9,338 ft. had been excavated and 15,693 ft. remained to be done. On recommendation of the consulting engineer a bill was passed authorizing the letting of the work by contract. It was stipulated that the work should be done in seven years at a cost not exceeding five millions.

Two Canadian engineers, Messrs. Walter and Frank Shanly, were awarded the contract. The amount to be paid was a little over four and a half million dollars. The driving of the tunnel was done from three points at the same time. The bore was pushed in from the outside of the mountain at each side. A central shaft was sunk in the mountain down to the tunnel level and at the bottom of this pit the tunnel headings were driven toward the east portal. It is recorded that when the east and central shaft headings met, 1,563 ft. from the central shaft, the lines were found to be out only 5/16 of an inch.

The tunnel itself, which is for the most part through mica schist, is 26 ft. wide and about 25 ft. high. It contains two tracks. One of the ventilation shafts, which is the one sunk by the contractors to give them a third point of attack, is not exactly midway in the tunnel. It is 12,244 ft. from the west end and is 1,028 ft. deep. It rises to the summit of the mountain, and is about 400 sq. ft. in area. The other ventilation shaft is about 2,500 ft. from the west end and is 318 ft. deep. The tunnel is four and three-quarters of a mile long and is one of the most notable feats of engineering in the whole of New England. The Hoosac mountain is situated close to the northern State line of Massachusetts and in fact its northern end extends up into Vermont.



HORSE SHOE CURVE NEAR ZOAR, MASS., ON THE BOSTON & MAINE.

Our frontispiece this month shows the Continental Limited on the Boston & Maine rushing westward like the "star of empire." Our other half-tone illustrations give a good idea of the beautiful scenery along the line. A view of the west portal of the tunnel shows the first entrance made which was subsequently abandoned. The road follows generally along the course of the Miller's and the Deerfield rivers and is in the very heart of the most picturesque and beautiful part of the whole country.

MILLER'S RIVER AT ROYALSTON, MASS., ON THE BOSTON & MAINE.

Machine Shop Reminiscences.

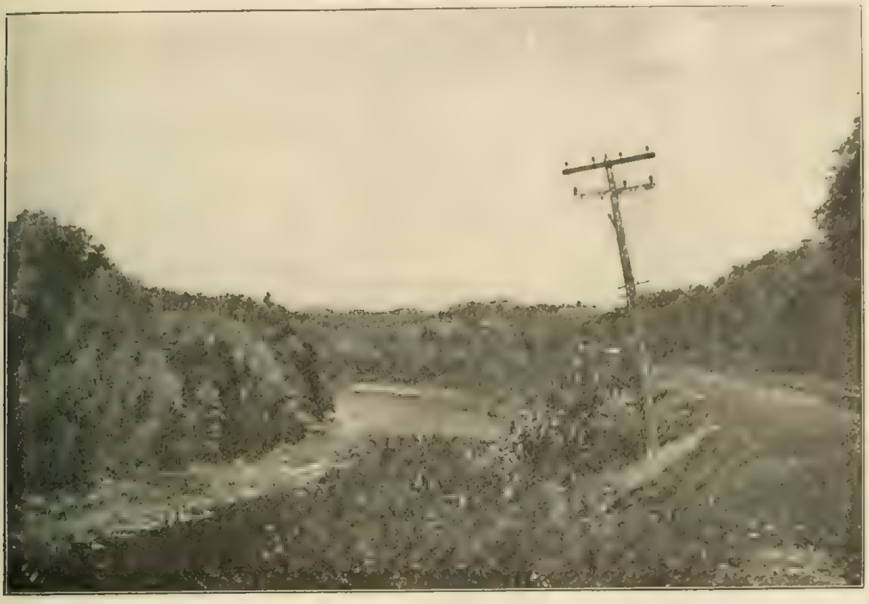
BILLY'S BANK BOOK.

When Billy's time was out, he was going to begin saving money—not this month, but the next. When the next month came, he was further away from extending his financial foundation than ever. At noon hour as soon as he got back from Clark's parlors he waxed eloquent on the stability that a bank book gives a man. It was the hall mark of respectability. Anybody could learn to chip or file or run a lathe or a planer, but it took a high, heroic soul to learn the road to the savings bank and to keep on walking in it month after month. As soon as he had his teeth fixed, and a new suit, he would show us all an example. Everybody was jealous of the budding financier. The contemplation of the unaccomplished is awe inspiring. It leaves something for the imagination. The unknown is ever the magnificent, and so Billy acquired a reputation altogether foreign to his real character.

In Billy's case thought was fatal to action. Unfortunately Clark's parlors lay between his boarding house and the savings bank, and, of course, he had to call in there to figure out how much he would put in the bank for a start. The discussion usually ended in laying the matter over till next month, and so the months went by like dreams, and Billy's bank book remained like Wordsworth's cuckoo, "an invisible thing, a hope, a mystery."

Things came to a climax in mid-winter.

The locomotives had increased in number and size, while the sheds seemed to have diminished. Portions of the tanks were projecting out into the open air and the winds let loose from some glacial caves in the Northwest were whistling melancholy tunes as an accompaniment to the usual round house pandemonium. Extra men were called to help the night gang. Billy was on a midnight job—a broken truck spring. It was a case of gathering from the far ends of the far reaching round house hydraulic jacks that acted as if they were on a strike. Great blocks of wood, water-soaked and heavy as lead had to be brought from dark corners. Between the truck and the tank there were icy formations grim as Alpine glaciers. The safety chains and brake rods were sheathed in crystal, and as Billy's feeble fingers convulsively clutched at the elusive pins the ice fell in fragments, sharp-cornered and ponderous as blacksmith's anvils. It was a rough job and a fierce night. Billy's new teeth rattled like dice. Shrieking steam bursting from throbbing safety valves rent the startled air. Whistles were wildly screaming for invisible hostlers. Cataracts of water from overhead roared and rattled as it mixed among the hissing masses of fiery cinders in the filth laden pits beneath. The clanging of bells and the clashing of loose-jointed car trucks lumbering along the uneven rails on the passing tracks sounded terrible in Billy's startled ears. Red and green eyes glared at him out of the darkness. The heavy pinch bar stuck to his frozen fingers. Billy was stuck. Billy was all in.



DEERFIELD RIVER ALONG THE LINE OF THE BOSTON & MAINE.

Jack Macfarlane and Shaw, the ex-fishmonger came along and put a new spring in, and thawed out Billy, and asked him how his bank account was getting on, and how it was that a man with a bank book would care to make a few hours overtime in weather like that when other men with large families and no bank account at all would like to have the chance to make an extra dollar. Billy was thinking his own thoughts. The iron was in his heart. Like the prodigal son Billy had struck bottom, but there was something of a man left. Next day was pay day, and Billy walked heroically past Clark's parlors and deposited five dollars at the Beehive Bank. His head was buzzing with visions of manly independence and financial stability. The bank book was bound in calf and had a broad elastic band around it. The first day it fell out of his pocket as if by accident and Billy hastily returned it. The news spread like wildfire and Billy put forth the fresh blush of modest admission. The second day it was pulled out at Clark's parlors as if to pay for a double schooner of Clark's "best," but several bystanders offered loans rather than see Billy hypothecate his bank book, and Billy bore his financial honors thick upon him. The third day there was a commotion at Clark's parlors. Where was Billy? There was a run on the Beehive Bank and Billy in his overalls was in the "far flung battle line" of frenzied depositors. The police were clubbing them into order. The paying tellers in the Beehive were taking their own time leisurely counting out the withdrawn funds. The crowd increased. The dismal day crept on. The bank had funds enough to meet the emergency, and towards midnight it was Billy's turn. His bank book passed into the cashier's hands, and Billy's account was closed.

Next day at Clark's parlors Billy stood at the bar like Napoleon at St. Helena. He had met his Waterloo. He had made a heroic effort, but the glory he dreamed of was not for him. He spent the balance of the withdrawn funds on the spot, and delivered an eloquent harangue on the instability of our banking system, and closed with an exordium on the advisability of being among the foremost to stand from under when red ruin fell upon this fair land of ours. Heedless and unconscious of having contributed to the needless panic he wrapt himself in a mantle of self-complacency and turned to his old job and his new dreams. He took comfort in knowing that in panics of a financial kind, the last man in the row was the first to get left.

WEST PORTAL OF THE HOOSAC TUNNEL, SHOWING ABANDONED ENTRANCE.

The Otavi Railway.

By A. R. Bell.

The Otavi Railway in German South West Africa, which was built by Messrs. Arthur Koppel for the Otavi Mines and Railway Company, has the distinction of being the longest narrow gauge light railway in the world, and it was completed in less than three years at a rate of over 120 miles per year.

The railway is built to a gauge of 600 mm., or 1 ft. 11⅝ ins. The rails are 90 mm. (3 9-16 ins.) high and weigh 15 kg. per metre (30 lbs. per yard). They are all in lengths of 9 metres (29 ft. 6 ins.), and the maximum wheel pressure is 3.5 tons. The sleepers or ties are made of steel, each 1,248 mm. (4 ft. 1¼ ins.) long, and weigh 12 kg. (24 lbs. per yard) each. Every section of 9 metres has 13 sleepers, so that the distance between the sleepers is 710 mm. (28 ins.). Steel sleepers have been used throughout, with the exception of the rails on bridges, which are laid on oak sleepers. The rails are fixed to the sleepers by means of steel clips and bolts and nuts. The clips are of various sizes and allow of the gauge being widened on the curves by 24 mm. The track, including sleepers and fittings, weighs about 1 cwt. per metre.

There are not many severe gradients on the line, the steepest being 1 in 50. The standard radius generally adopted for the curves is nearly 500 ft., with the exception of about 10 places, where a smaller radius has been adopted in order to avoid cutting through the rocks. No special material was required for the ballasting of the rails, as the quartz sand found everywhere proved of an excellent material for this purpose.

The turntables have a carrying capacity of 25 tons and a diameter of 4.5 metres, with platforms made of chequered steel plates turning on 14 steel rollers, the centre pivot serving as a support for the rollers only, so that the friction is reduced to a minimum. All the bridges on the line are of steel, and they are designed for a carrying capacity of 6.5 tons per axle. There are 110 bridges in all, the longest being about 330 ft., composed of five spans of about 66 ft. each.

NARROW GAUGE RAILWAY CUT, OTAVI RAILWAY.

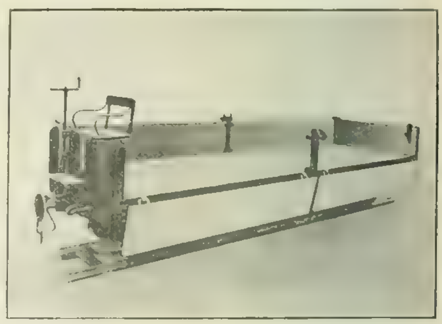
Besides Swakpmund and the terminus Tsumeb, there are three stations on the line—one at Usakos, about 95 miles; one at Omaruru, about 145 miles, and a third at Otjivarongo (235 miles), and furthermore there are 42 sidings.

The greatest difficulty that had to be overcome, besides the supply of labor, was the question of providing water. No water could be found between Swakpmund and Usakos, but even the water at Swakpmund and Usakos could not be used for feeding the boilers without being previously softened, and water softening plants had consequently to be erected. A large repair shop has been built at Usakos, fitted with a complete set of machines for repairing and overhauling the locomotives and rolling stock. The necessary power is supplied by a 40 horse power engine. A fitting shop has also been put up at Swakpmund, where all the rolling stock is erected.

The first type of locomotive that has been supplied has six coupled wheels and a pair of trailing wheels. The centre driving wheels are flat rimmed, so as to facilitate curving. The principal dimensions are the following: Cylinders, 12 x 14 ins.; diameter of driving wheels, 28 ins.; diameter of trailer wheels, 22 ins.; heating surface, 495 sq. ft.; grate area, 8.61 sq. ft.; working pressure, 176 lbs.; weight in working order, 22.7 tons.; weight empty, 15.5 tons; rigid wheelbase, 5 ft. 7 ins.; total wheelbase, 11 ft. 6 ins.; tractive power, 2,800 kg., or about 6,000 lbs.; total length, 23 ft. 6 ins.; total width, 7 ft. 3 ins.; total height, 10 ft. 6 ins.; tank capacity, 770 gallons; coal bunker capacity, 1 ton. The locomotives are capable of hauling a gross load of 78 tons at a speed of 25 km. per hour on a level, or at 15 km. per hour up a gradient of 1 in 50.

Owing to the increase in traffic a larger and more powerful type of engine was adopted later on, and this type was built to the following principal dimensions: cylinders, 12⅜ x 18 ins.; driving wheels, 34 ins.; trailers, 22 ins.; rigid wheelbase, 6 ft. 4 ins.; total wheelbase, 13 ft. 3 ins.; working pressure, 176 lbs.; grate area, 10.76 sq. ft.; total heating surface, 610 sq. ft.; tank capacity, 220 gallons; coal bunker capacity, ¾ ton; weight in working order, 22.8 tons; weight empty, 18.1 tons; length, 25 ft.; driving wheelbase, 7 ft. 3 ins.; height, 10 ft. 6 ins.; tractive power, about 8,000 lbs. These locomotives haul, exclusive of their own weight, a gross load of 100 tons at a speed of 40 km. per hour on a level, or at a speed of 15 km. on a gradient of 1 in 50.

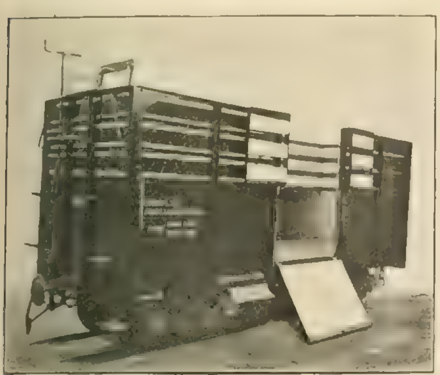
Owing to the scarcity of water, each train has its separate tank wagon, and for this reason the larger engines are not of the saddle type, but separate tenders are attached carrying 10,000 litres of water and 3.5 tons of coal each. Each engine has two injectors and a duplex feeder pump. Altogether there are now 36 locomotives and 20 tenders on the line. On account of the conditions which had to be considered there are a great many types of goods wagons in use. The open



SMALL GOODS WAGON, OTAVI RAILWAY.

goods wagons were at first constructed as low-sided trucks, but this construction was changed and the wagons supplied later on were fitted with high sides. The low-sided goods wagons have no doors at all, but are so constructed that the sides can be swung down. The sides of all open goods wagons rest in sockets and can if necessary be removed altogether. All open goods wagons have a carrying

capacity of 10 tons and a floor space of 83 sq. ft. and a tare of 4.4 tons. To reduce the wheel loads and to go easily round curves each wagon runs with two four-wheeled bogies, a self-acting brake applied to four wheels. Up to the present the railway owns 132 low-sided goods



LARGE FREIGHT CAR, OTAVI RAILWAY.

wagons, 52 high-sided, 20 covered goods wagons, and five cattle trucks.

The State Railway running from Swakpmund to Windhoek, which connects with the Otavi line at Swakpmund, has rolling stock with a different buffer gauge, and to allow of the different types being coupled together, special trucks have been designed with extra deep buffers, and 10 of these trucks are now in constant use.

There are up to the present only three passenger coaches on the line—first and second class. Each first class car accommodates 12 passengers, eight inside and four on the platform; while the second class cars have seats for 12 passengers inside and four on the platform. To make the cars secure against wind pressure, the space between the channels of the underframe has been filled out with concrete, reinforced with iron bars, and the floor is about 6 ins. lower than the platform. Each car has a carrying capacity of 10 tons and weighs inclusive of the concrete ballast, 6.2 tons.

A special car has been provided for the inspecting engineer and directors of the company. This car has a compartment serving as an office, sleeping compartment and three folding beds, bathroom and kitchen. During the construction a number of motor velocipedes were used by the engineering staff.

All passenger cars run on four-wheel bogies, and are fitted with hand-screw brakes to be worked from the platform. The rolling stock has been subjected to severe service tests from the very first.

The total expenditure, including all the rolling stock, amounts to about £900,000, or $4,374,000, and the cost of laying the track, including rails, sleepers, earthwork, cuttings, etc., as near as can be estimated, to about £2,300 per mile ($11,178). The contractors are negotiating for contract to reconstruct the harbor of Swakpmund, the German colony's only port.

Bound Volumes of "L. E."

The bound volumes of RAILWAY AND LOCOMOTIVE ENGINEERING for the year 1907 are now ready and can be secured on application to our office, 136 Liberty street, New York. Cast your eye over the index which was issued with the December number and you will readily see how varied were the topics dealt with during the past year. If you are short of copies and want to make up a set, you will have to send in your order without delay. The easiest and best way is to get a bound volume. Price, $3. You then have the whole year's work in most convenient form.

Among the Railroad Men.

By JAMES KENNEDY.

AT MICHIGAN CITY, IND.

Michigan City on the southeast corner of Lake Michigan is blossoming into a very popular summer resort. Its attractions are hardly up to the nerve-racking standard of Coney Island, or the starry brilliance of the Board Walk at Atlantic City, but it is wonderful what a few years will do. The most puzzling thing to a stranger is to ascertain what o'clock it is. Michigan city is not alone in this particular. The traveller from the East finds his troubles beginning at Salamanca, N. Y., and they continue till he reaches Chicago. Everybody there seems agreed that they are an exact hour behind New York in the matter of time, but they claim to be ahead in everything else. This mixture of time is a disturbing element to all except those in the employ of city departments, who prefer to begin work on Chicago time and drop off at New York time, and so have a hour more to themselves. Of course there is no such thing as the correct time anywhere. We are all laboring under the involved questions of solar, sidereal, apparent and mean time, but in some places they add to the wabble of the earth's axis, like apprentices experimenting with the valve motion of an overworked freight engine.

The Michigan Central Railroad running from Chicago eastward skirts the shore of the great inland sea. The road and rolling stock are in splendid condition. The repair shops at Michigan City are among the oldest on the Continent, but in the matter of appliances they have kept pace with the times. A stationary engine of the date of 1848 is still doing excellent service. It is furnished with a valve gearing having a strong resemblance to the Alfree-Hubbell variety. Mr. E. R. Webb, M. M., spoke in the warmest way in regard to the performances of a number of cross compound locomotives in the company's service. He claimed that the records of expenses showed that in runs of 1,000 miles the cross compound could be run at 10 cents per mile as against 16 cents in the case of simple locomotives. On the question of the adoption of the Walschaerts valve gear on the larger class of locomotives, Mr. Webb spoke very conservatively in favor of the Stephenson gearing, the increase in the valve opening in the latter type being an important factor in its favor, as against the fixed lead of Walschaerts' invention. Mr. Webb admitted that the accessibility of the new type of gearing made up for some of its organic defects. Both Mr. Webb and Mr. H. W. Coles, the gentlemanly chief clerk, spoke in the warmest terms of the educational work of RAILWAY AND LOCOMOTIVE ENGINEERING and of its great and growing popularity among the men of the Michigan Central. The shops are beautiful situated near the lake and the surroundings are of

REPAIR SHOPS AT USAKOS, OTAVI RAILWAY.

the most artistic kind. Important enlargements are being spoken of in the near future.

AT ELKHART, IND.

The round house of the Lake Shore and Michigan Southern Railroad at Elkhart, Ind., is worth going a long distance to see. Those who have worked in roundhouses so small that ten or fifteen feet of the modern locomotive projected out in the wintry blast can immediately recognize the degree of comfort with which roundhouse work can be done at Elkhart. A grand promenade, as wide and smooth as a city boulevard, sweeps around inside the great circus, and the splendid locomotives look small in the vast amphitheatre. Every modern appliance in use in locomotive repairing is there in perfection. The pits are like porcelain, the floors are like alabaster, the air is balmy as June. By day the light streams through a roof that is translucent. At night the electric lights are thicker than the stars in the milky way. Wheels disappear like magic from under the engines and come up again outside the engine while you wait. The best machinists prefer being in the roundhouse because the 800 men in the machine shops are getting crowded as the expanding business of the road calls more locomotives into service.

Mr. M. J. McCarthy, the master mechanic, and his worthy assistant, Mr. O. M. Foster, manage to keep the locomotives in splendid condition. Every new appliance is at their disposal and all they need is more space for the fine machines which are rapidly replacing the tools that have done excellent service in their day. The mile a minute runs made by the passenger locomotives are looked upon as a matter of course on the level stretches of Indiana, 134 miles in 135 minutes being a daily record for a group of their regular passenger engines. Their best record for the same run is 115 minutes. This exceptional figure was made by one of the latest locomotives built by the American Locomotive Company and furnished with the Walschaerts valve gear. Mr. McCarthy claimed that there had not been a single failure in two years arising from the use of the Walschaerts valve gear. As a matter of fact the gearing had passed outside of the pale of the consideration of the engineers. It stands like the smokestack, or like the piston rod, requiring nothing but a little oil on the massive joints. The bearings on the gearing look amazingly strong and one can see at a glance that there is nothing that could accumulate lost motion excepting perhaps the ponderous bronze bearings on the return crank.

In the capacious roundhouse there is a revolving index cylinder showing where all the locomotives are and the names of the engineers and firemen attached, and, in brief, a complete bird's eye view can be had of the entire division having its centre at Elkhart. At the polar extremities of this globular arrangement there is a kind of limbo or place of darkness where the names of engineers or firemen off on a holiday can be seen, and this open display seems to have a steadying effect on the men, as one naturally wishes to be seen at the post of duty like the sentinel at the gate of Herculaneum. Mr. H. A. Keyser, the scholarly chief clerk, showed us the mysteries of this revolving storied cylinder, and it looked as if the whole world was before us, and we could see in our mind's eye a vision similar to that which came to the poet Butler when he cleverly declared that

"Geographers on pathless downs
Placed elephants instead of towns."

Preserving Railroad Ties.

E. A. Sterling, Forester of the Pennsylvania Railroad, has just returned from an inspection of the large wood-preserving plants in the far West He reports that Western railroads are now treating a large percentage of their ties, piling and constructing timber, with creosote and other oils, similar to the way European roads have been doing for some years. The timber in the West used for railroad purposes, pine and fir, are less durable than oak, the standard wood of the Eastern roads, and without creosoting soon decay. Among the railroads in the West now treating timber is the Santa Fe, which has a large creosoting plant at Somerville, Texas. This plant has a capacity of 15,000 ties a day. The Santa Fe is also building a new plant at Albuquerque, New Mexico, where crude oil will be substituted for creosote. In addition to treating the timber the Santa Fe is planting Eucalyptus trees on a 9,000-acre tract near San Diego, Cal. The timber manager of this company has been sent to Australia to look up new species of trees.

The Southern Pacific operates two plants at West Oakland, Cal., one at Houston, Tex., and another at Los Angeles, Cal. Red fir and pine are being treated. In the Northwest, the Oregon Railroad & Navigation Co. maintains a zinc chloride and creosoting plant at Wyeth, Ore.

Among the more important new treating plants in course of erection are two by the Northern Pacific; one very large plant by the Burlington at Galesburg, Ill.; four by the Rock Island, and two or three by the Illinois Central.

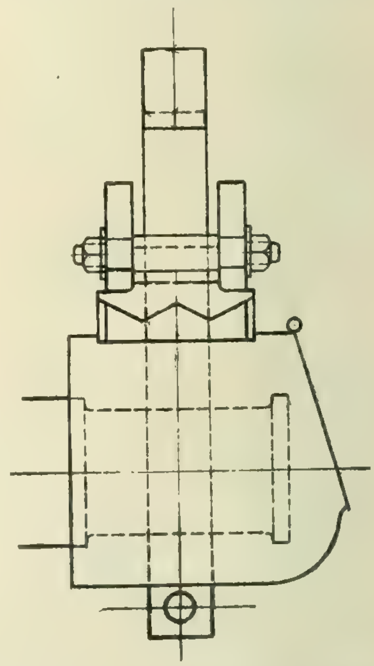
As a protection against a possible diminution of lumber for railroad ties in the future, the Pennsylvania Railroad have undertaken large tree planting operations since the appointment of a forester. Work upon a large basis is progressing at Mt. Union, Pa., where about 225,000 trees have been planted. At Altoona 250,000 or more red oak trees were set out last spring. At Hollidaysburg a forest nursery is being created, about 135 lbs. of seed being planted this year in nursery beds, and many trees being set in nurseries for use next year.

Wabash 2-6-2 Fast Freighter.

Not long ago there were thirty engines of the 2-6-2 type supplied to the Wabash Railroad by the American Locomotive Company. In view of the comparatively small number of Prairie type locomotives built, the completion of this order by the Rogers Works is particularly interesting.

These engines are intended for fast freight service, but they will also be used to some extent in passenger service. A number of the same class have been in service on the Wabash for over a year, and it is reported that their performance has been very satisfactory both as to tonnage capacity and cost of maintenance. They are operating on grades of from 26 to 45 ft. per mile and are handling from 1,750 to 2,100 tons. The general appearance of the locomotive recently built is shown in our half tone illustration.

The engines are simple, having cylinders



ARRANGEMENT OF TRAILING JOURNAL BOX ON WABASH ENGINE.

22 x 28 ins. and 70-in. driving wheels. This, with a steam pressure of 200 lbs., gives a tractive effort of about 32,900 lbs., and the factor of adhesion is 4.3, as the total weight carried by the drivers is 143,100 lbs. There are several features which differ sufficiently from the usual practice to be of special interest. Principal among these is the design of the cylinders, which are provided with piston valves, and the arrangement of the valve

motion, which is of the Stephenson link type.

The cylinders are so constructed that the centers of the valve chamber are midway between the upper and lower rail of the frame and almost in line with the frame centers. This permits of the use of a rocker shaft placed on the lower rail of the frames just ahead of the forward pedestal, with a single upward-extending arm inside of the frames to which the valve rod and the transmission bar are both connected. This is done in order to bring all the parts of the valve motion more nearly into the same vertical and horizontal planes than they are with the usual design of piston valve cylinders when the Stephenson link motion is used.

The frame construction also differs somewhat from usual practice. The main frames are of cast steel with double front rails. The upper rail is spliced to the main frame in the usual way and is bolted to the front bumper, while the lower rail is integral with the main frame and extends only beyond the cylinders. The principal difference in frame construction, however, is the use of two auxiliary rails independent of the main frames, placed 11½ ins. on each side of the center line of the engine, and bolted to the bottom of the cylinder saddle and to the filling casting just ahead of the cylinders. Both of these features of the design have been standard practice for this type of engine on the Chicago, Burlington & Quincy Railroad for a number of years.

The trailing truck is of the outside bearing side-motion type, and the trailing wheels carry a load of 34,000 lbs. The engine truck supports 26,000 lbs., and these figures, with those already given for the adhesive weight, make up a total weight in working order for the engine, of 203,100 lbs. The tender weighs 155,317 lbs., so that what may be called the grand total comes up to 358,417 lbs. The driving wheel base of the engine is 13 ft. 4½ ins. That of the engine itself is 30 ft. 8½ ins., and when that of the tender is added the total wheel base becomes 63 ft 4½ ins. The engine truck wheels are 37¼ ins. in diameter, and the trailing truck wheels are 42½ ins. The piston valves of this engine are inside admission and have a maximum travel of 6⅛ ins. They are set with 1-32 in. lead in full gear and have a steam lap of 1⅛ ins. and inside lap of ⅛ in.

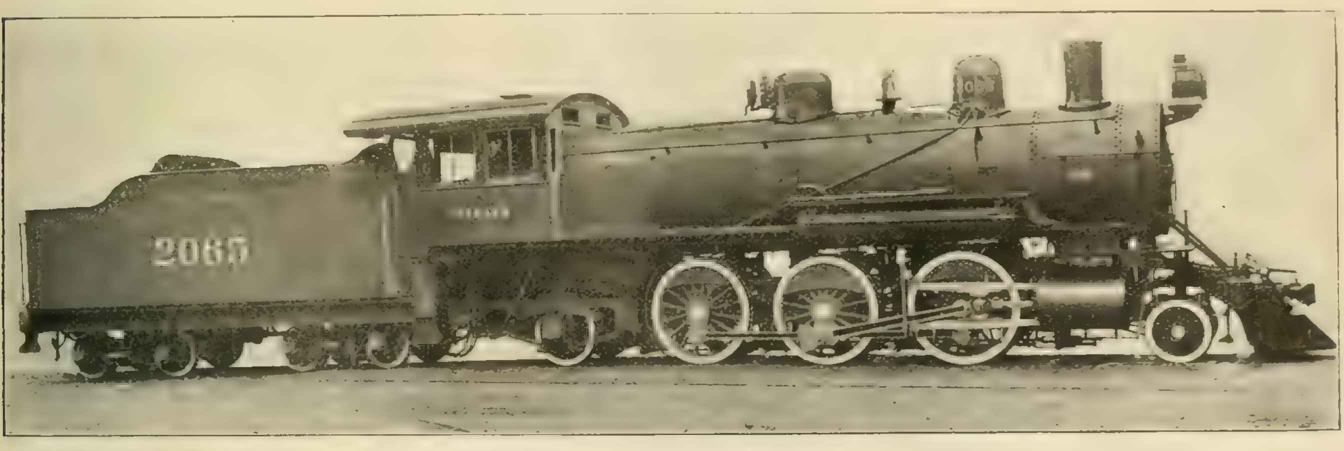
The American Locomotive Company is also completing an order of 30 more engines of the same type for this road which are duplicates of the locomotives here illustrated, with the exception of 64-in. driving wheels and 33½-in. truck wheels.

The boiler is of the extended wagon top type, 70 ins. in diameter at the smoke-box end It is equipped with the Barnes boiler skimmer, designed by Mr. J. B. Barnes, the former superintendent of motive power of the road. A detailed description of this apparatus was given in the April, 1907, issue of RAILWAY AND LOCOMOTIVE ENGINEERING on page 176. The boiler contains 3,559 sq. ft. of heating surface made up of 190½ in the fire-box and 3,368½ sq. ft. in the tubes, of which there are 301. They are 2¼ ins. outside diameter and are each 19 ft. long. The grate area is 54¼ sq. ft., and this gives a ratio of grate area to heating surface of as 1 is to 65. The heating surface of this engine is, roughly speaking, about the same size as the area of a circle having a diameter equal to the length of the engine and tender, which is in the neighborhood of 67 ft. 4 ins. The fire-box of this engine is called wide, inasmuch as it comes out over the frames. The box is 108⅛ ins. long inside and 72¼ ins. wide. The injectors used are two No. 11 of the non-lifting type.

The tender is made with steel channel frame and the tank has a water bottom. It will hold 7,700 gallons and carry 15 tons of coal. The trucks are of the arch bar type and the wheels are 33½ ins. in diameter.

A few of the leading dimensions are appended for reference:

Driving Journal—Main, [illegible] ins. x 12 ins.; others, [illegible] ins. x 12 ins.; eng. truck, 6 ins. x 10 ins.; trailing, [illegible] ins. x 12 ins.; tender, [illegible] ins. x 10 ins.
Boiler—Thickness ring, first [illegible] in., second ¾ in., third [illegible] in., [illegible] in., dome, 9-16 in.; front tube, ½ in.; roof, 9-16 in.; side, [illegible] in., back head, [illegible]
Firebox—Length, [illegible], width, [illegible] 61⅞ ins., thickness, crown [illegible] in., tube [illegible] in., side, ⅜ in., back, [illegible] in., water space, front 4½ ins., side 4 ins., back 4 ins.
Seams—Horizontal, sextuple riv.; circumferential, double riv.
Staybolt, Material: Staybolt iron, [illegible] and ⅞ in. dia.
Crown Stays—Staybolt iron, [illegible]
Boxes, Driving material, main, [illegible]
Crank Pins—Size main, 7 ins. x 7 ins.; main side, 7½ ins. x 7 ins., front, 6¼ ins. x 3½ ins.; back, 6¼ x 3 [illegible] ins.
Exhaust nozzles, C. I., 5⅜ ins. dia.
Smoke Stack—Diameter at choke, 19½ ins.; top above rail, 15 ft. [illegible] ins.
Tender—Weight empty, 61,150 lbs., wheel base, 19 ft. 6 ins.
Driving Wheel—Center, material cast steel; tires, held by shrinkage.
Westinghouse E. T. brakes
Gold steam heat.



FAST FREIGHT 2-6-2 FOR THE WABASH RAILROAD.

E. F. Needham, Supt. Loco. and Car Depts. American Loco. Company, Builders.

Practical Advice to Firemen.

A highly practical railroad superintendent who had been impressed with the success achieved by a certain engineer at both sides of the cab, asked the man to write out some advice for firemen ambitious to become experts in their business, and the following letter was prepared:

"He should be a temperate, honest man, of at least medium size, and should have a good education. He should go to his engine an hour before leaving-time, and should examine the fire, grates, ash-pan and front end, if the engine is of that make, and should see that there are tools and supplies for the trip, and in fact know that everything is in readiness. He should have his fire laid, that is, have the grates covered with incandescent coal, the thickness to be governed by the amount of work the engine is about to be called upon to perform.

"After they have started and the lever has been cut back, he should give her a light fire, and if the engine is working hard repeat this often, having the coal cracked about the size of an egg.

Open and shut the door in the shortest possible time; avoid heavy firing, as it is wasteful in all ways, and a great source of annoyance to the engineer, especially in bad weather. Nearing each station he should allow the fire to burn down, so as to avoid smoke and popping, while the steam is shut off. When the engine is again started, be governed by the same rules as at the beginning of the trip. After being out fifteen or twenty miles he should see that the grates are loose by 'just moving them,' then after twenty-five or thirty miles shake them slightly; repeat this a few times during the trip. He might vary from these rules slightly according to circumstances, knowing that as he cannot shape them to him he must shape himself to them. While do in this case is to give the engine if he has not been called for duty, he may be called upon to perform, do it with dispatch.

"These rules may be followed to the end of the trip, and they will be all right where there is good boiler feeding being done. But when the 'feed' is shut off with the engine, and started with it, or just before, or is wide open or shut off at all times regardless of conditions, they will not. The way to do in this case is to give the engine enough of coal, that is 'try and keep her hot,' regardless of smoke, waste or anything. He should not bother the engineer with talk that does not concern his work or the engine; he should teach himself to think about his work as he does it; he should learn the 'peculiarities of the engine' and the cause for the same; he should recognize nothing as a mystery, but the effect of some cause; his duty is to learn the cause. After the engine has been housed he should get it ready for the next trip whether he goes out on it or not. But he should be given a regular engine to fire, as he can give better satisfaction to the company, the engineer and himself, and in this case he can afford to keep it clean, and I would advise him to do this, as it will make his work on the road more pleasant. Let cleanliness of person and engine be his motto.

"After his work is done he should go at once to his home, if he has one; if not, he should waste no time in getting one, and if he is in need of rest get it at once; after this has been done, and if he has not been called for duty, he should spend his time in studying or reading something treating on his work. In this way he will command the respect of his associates, as well as the officers of the road, and it will enable him to attend to his own affairs, a great requisite in a railroad man."

Artificial Shop Lighting.

What modern systems of artificial illumination mean to large manufacturing plants and railroad shops is well illustrated in the accompanying engravings from photographs taken by artificial light in the new locomotive shops of the New York, New Haven & Hartford Railroad at Readville, Mass. The main building, containing

BLACKSMITHS' SHOP AT READVILLE.

the erecting shop and machine shop with a gallery over one-half its width, is 904 ft. 6 ins. in length and 150 ft. wide. The blacksmith shop, which is illustrated from a photograph taken under similar conditions, is 354 ft. 6 ins. long and 80 ft. wide.

In the high bays, over the erecting floor and machine shop, and in the yard outside, the lighting is by series arc lamps assisted by Nernst four- and six-glower lamps over and under the gallery and along the central row of columns. On the benches along the

N. Y., N. H. & H. SHOP AT READVILLE, MASS.

outside walls Faries articulated fixtures carrying incandescent lamps are used, and in addition each machine tool is provided with an incandescent lamp. Provision is also made for the attachment of lamps for occasional illumination by a plentiful supply of Chapman light sockets along the center row of columns, on the outer walls and in the pits of the erecting shop.

The secret of most men's failure is mental dissipation, wandering energies, squandering energies upon a distracting variety of objects, instead of condensing them into one.—*London Chat.*

Romance of Malleable Iron.

What is known in America as malleable iron is used to a great extent on vehicles of all kinds because it is stronger than cast iron and less expensive than wrought iron or steel castings. What we call wrought iron is called malleable iron in Europe, which has led to considerable misapprehension about the real nature of our malleable iron.

Many people who are in a position to order malleable iron when they consider it suitable have very vague impressions concerning the nature or qualities of this material. They believe malleable iron to be ordinary cast iron that has been subjected to an annealling process that increases its strength and gives it toughness.

Seventy years ago there lived in Newark, N. J., Seth Boyden, a blacksmith by trade, who became a sort of Admirable Crichton in everything relating to the mechanic arts. This man, besides possessing great inventive and mechanical ability, was gifted with extraordinary acuteness of observation and faculty that ought to receive more encouragement than it does from the educational world.

When he was yet a lad Boyden noticed that a grate bar which had been removed from a furnace had apparently changed its quality on the part exposed to the fire. He broke off the part that seemed to have undergone metamorphosis and found that it could be drawn on the anvil. By some mysterious process the cast iron bar had become malleable.

Boyden proceeded to search for the secret cause of the change. All his spare time was devoted to the search, and after long and tedious experimenting he found out that when cast iron of a certain quality was kept at a high temperature surrounded by oxide of iron, the cast iron lost its high percentage of carbon and became soft, tough and malleable. The discovery was so important that Boyden had no difficulty in finding help to raise the means for making malleable iron as a business.

The castings are made in dry or green sand molds that do not differ materially from ordinary cast iron molding. The iron is poured very hot, and the product is a shiny gray, highly brittle casting, these characteristics being principally due to the selection of the pig iron. The castings are then put into square boxes where they are imbedded in oxide of iron mostly in the form of iron scale and rust. These boxes are then closed in a heating furnace, where they are kept at a very high temperature for about eight days, after which the furnace is permitted to cool gradually. As soon as the furnace is cool enough the castings are ready for cleaning. The metal thus treated possesses the desirable elements of toughness and durability, and has now a multitude of uses for which it is fitted as no other metal is.

General Correspondence

A Famous Trial.

Editor:

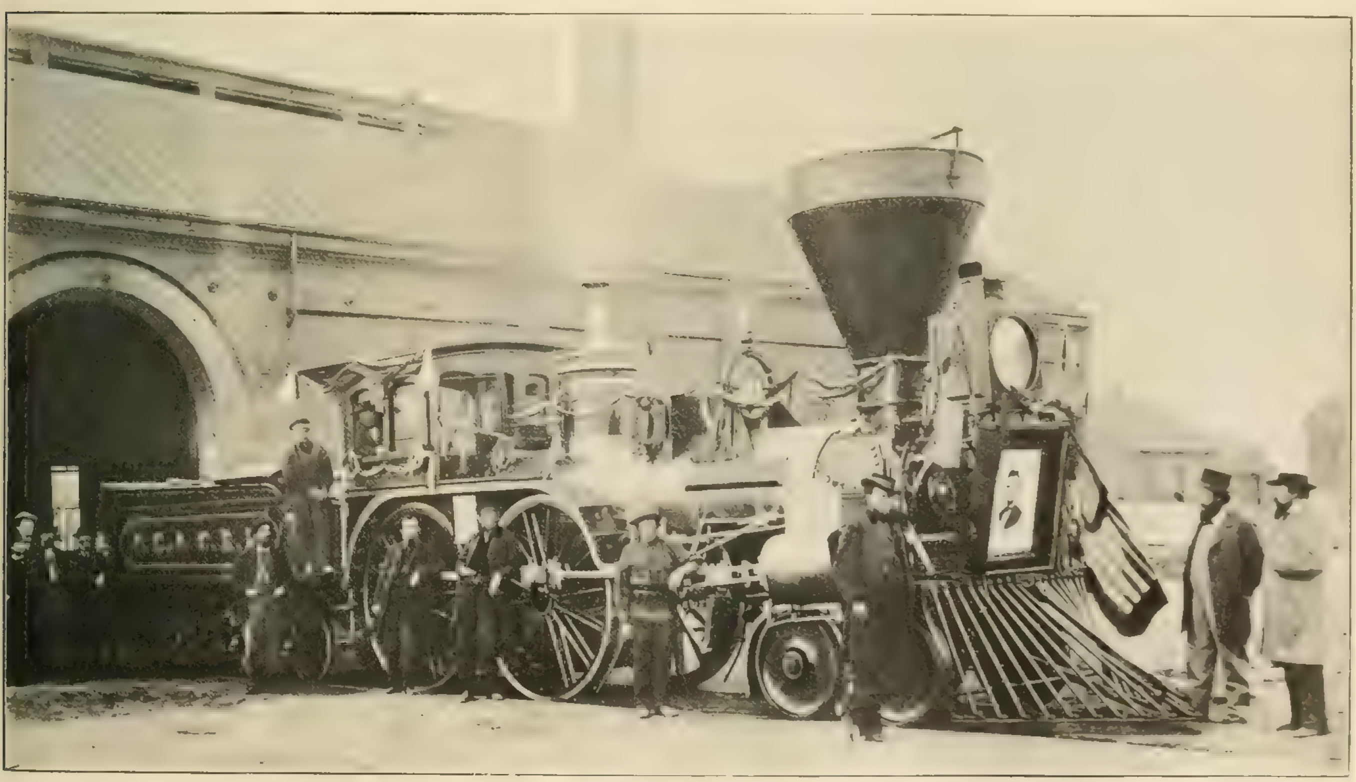
I am sending you by evening mail a photograph of my father and a photograph of the old engine "Nashville." This engine was used to haul President Lincoln's funeral train from Cleveland, Ohio, to Springfield, Ill., and is a Cuyahoga engine, and is the one which made such a wonderful showing years ago when used in a competitive test against the Taunton engine "Leonard Case."

My father was born in Kilcullen Bridge, County Kildare, Ireland, on October 2d, 1830. After serving an apprenticeship in the dry goods business, he left Ireland in 1849. Going to Cleveland, Ohio, he served an apprenticeship as a shipsmith. Afterwards fired a locomotive on the old Cleveland, Columbus and Cincinnati Railroad, called the "Bee Line." After firing two years was promoted to engine dispatcher at Cleveland. A little further on was promoted to the position of locomotive engineer and ran the old switching engine "Myron Dow," which took its name from a man who previously had done the switching by the use of a horse.

THOMAS WALSH.

By this time there was a great deal of competition between the Taunton Works of Taunton, Mass., and the Cuyahoga Locomotive Works of Cleveland, Ohio, as to the merits of the locomotives built by the respective companies. A competitive test was agreed on. The engine "Nashville," engineer George Westfall, fireman my father, who, although he had been promoted to the position of engineer, was requested, on account of his skill as a fireman, to fire the "Nashville," and with Taunton engine named "Leonard Case," engineer Wm. Warner, fireman Ben Blaisdell. These engines had previously been used regularly to haul the same train, four cars, between Columbus, Ohio, and Erie, Penna.

The result of the trial was that the Cuyahoga engine "Nashville," hauling four cars, with one tender of wood, hauled the train from Columbus, Ohio, to Erie, Penna., and back to Painesville, without taking on any more wood, a distance of three hundred miles, while the Taunton engine "Leonard Case," with the same train, and under the same conditions, left Columbus, Ohio, with a full tender of wood, and only got as far as Grafton, 115 miles from Columbus, until they had to put on more wood. The engineer of the Cuyahoga engine "Nashville," George Westfall, was presented by the Cuyahoga Works with a gold watch and my father a silver watch.



OLD ENGINE "NASHVILLE," DRAPED FOR FUNERAL TRAIN OF PRESIDENT LINCOLN.

Later on my father ran local freight, through freight and passenger trains, and for many years a construction and wood train. He left the old Cleveland

and Columbus road in 1871 and took up construction work on the C., L. & W. Railroad, which was then building After completing that road, he went into the construction work on the Cincinnati Southern Railroad, and after the completion of that road he was made roundhouse foreman, and afterwards master mechanic, at Sommerset, Ky., where he remained until 1893, at which time he returned to Cleveland, Ohio, and since that date and up to the present time has been in the employ of the City of Cleveland, in its city engineering department, having charge of their street paving. He is still in excellent health as his photograph will indicate.

I will be under many obligations to you to take the best of care and return to me the photograph of the engine "Nashville," as it has been in the family for about fifty years.

J. F. WALSH,
Supt. of Motive Power C. & O. Ry.
Richmond, Va.

[The incident of the competition between the two engines referred to above is thus described by Angus Sinclair in his latest work, "The Development of the Locomotive Engine." He says: "There were good talkers among the engineers of those days, who were not afraid to express in language, often more expressive than polite, what they thought in favor of their own engines or in disparagement of others, and many a summer day was made warmer as a group of engineers on the shady side of the roundhouse whittled, bragged and bantered each other. Once, after an unusually warm debate over the performance of a newly-arrived Eastern engine, as compared with a pet engine built at the 'old Cuyahoga,' it was decided to have a trial of the two engines in order to settle the matter.

"The consent of the master mechanic having been obtained, a trial was arranged, which in every respect differed from the trial trips as now made. What they wanted to know was which of the two engines, having the same quantity of wood and water, could go farther on the same day and over the same track. So it was arranged that the 'Cuyahoga' engine and the Eastern should both start on an equal footing from Columbus, and run as far as they could towards Cleveland without replenishing fuel or water. It may well be understood that each engine was put in the best possible trim, and each engineer and fireman was at his best. Along the line at every town were gathered the railroad men, from the wood sawyer to the station agent, to greet and cheer their favorites as they sped along northward, until, at last, the Eastern engine struck the descending grade several miles outside Cleveland, and by its aid it managed to crawl into the depot bereft of wood, water and steam. Then the query was, where was the Cuyahoga engine, of which so much was expected? Had it gone dead and cold somewhere back in the woods, and would another engine have to be sent out to drag it in, lifeless and disgraced?

"For a while it looked blue for the Cleveland boys, but not long, for soon their pet engine was seen bowling down the grade, and as it neared the depot the crowd parted to clear the track, when the engineer motioned to open the switch leading to the Lake Shore track. Then with a defiant blast of victory it dashed on towards Buffalo and never stopped until it reached Painesville, thirty miles away. The test was considered complete in favor of the backwood built engine."—ED.]

SPANISH MAIL IN THE PYRENEES.

Across the Pyrenees.

Editor:

In renewing my subscription for your esteemed paper for the next year I enclose two photographs of Spanish railroad scenery in the Pyrenees mountains. The pictures are taken on the future Trans-Pyreneen line, that will start from Barcelona, having its culminating point at Pringcendre. It will run over Toulouse to Paris. Hoping that one of these pictures will find a little place in your paper.

A SPANISH "DOUBLE ENDER."

EDMUNDO BEBIE.
La Farga, Barcelona, Spain.

High or Low Steam Pressure.

Editor:

There has always been a difference of opinion among firemen about the relative advantages of high pressure and low pressure steam, a belief being widespread that an even steam pressure can be more easily maintained with low pressure than with high pressure. When the intensely high boiler pressure came into vogue many engineers and firemen thought that they could do better by permitting the steam to fall 20 lbs. or more below the popping point and keeping it there. I hold that the higher the steam pressure carried the less steam will be used in doing certain work and my experience teaches this to be true.

When I was a fireman this question of high against low steam was a much discussed subject on the road where I was working, and I wrote a letter to LOCOMOTIVE ENGINEERING stating my practice and views, which were endorsed by the editor. The letter read:

"There is a difference of opinion in regard to a point on firing which we would like to settle through your valuable paper. I am firing a passenger engine. We have a Baldwin engine which carries 160 pounds of steam. Forty-six miles of the division is up grade, eighty-seven miles more to the end of the division is up and down, undulating as they call it. The point in dispute is concerning the best method to save coal. Some claim that by firing an engine so that the steam will not exceed 120 to 140 lbs., or from 20 to 30 lbs. short of the blowing off point, the maximum fuel economy will be secured. I claim that you waste coal by that practice. The engines are free steamers, and you have to let the fire burn so low to keep the steam down that when you throw in fresh coal down goes the steam, and consequently you have to work under great disadvantages. By keeping a good fire to build on and carrying from 140 to 155 lbs. of steam without permitting the safety valves to pop you can save coal.

"A FIREMAN."

[We answered that this correspondent's method of firing was correct. We say the same thing about engines carrying 200 lbs. steam pressure. Keep the steam as near as possible to the blowing off point if you want to obtain the greatest economy.—ED.]

Old Timers of the Long Ago.

Editor:

I am sending you some photographs of old timers; you can fix them up to suit yourself. I have quite a number of pictures of the long ago which I think would interest some of the old time engineers. I was very much pleased

with the old Hackensack in one of your former issues. She was working on the ash pit at Jersey City when I was firing on the Erie.

I have a very fine picture of the Amoskeag built in 1851 with a dome boiler, cylinders 15 x 20 ins., six driving wheels. I have a picture of the same make of engine which I made myself done in water colors. She was a famous engine on the Rutland and Burlington Railroad in the sixties.

THE "WILLIAM HALE," AN OLD "49ER," ON THE RUTLAND.

The "William Hale" was an inside connected engine used on the Rutland Railroad. She was built at Taunton, Mass., in 1849, and rebuilt in 1866, and was sold to the Burlington and Lamoille Valley Railroad in 1877. The cylinders were 16 x 20 ins., and she had 5-ft. driving wheels. Her name on the Rutland was "Mount Holly."

The "Mansfield" was built by Wm. Mason at Taunton, Mass., 1876. Cylinders 16 x 24 ins., drivers 4 ft. 6 ins., Walschaerts valve gear. She was our freight engine on the Burlington and Lamoille Valley Railroad. She could draw all you could hitch on.

Burlington, Vt. WM. LINSLEY.

Early Railroading Around Dayton.

Editor:

It will perhaps be interesting to the railroad men of Ohio as well as those of Dayton to read an account of early railroading in and out of Dayton. What a change there has been since the first railroad in the State has been built. It was then the old Sandusky, Mansfield & Newark Railroad, and was built in the early forties.

The second railroad in the state was built in 1849, and was known as the Mad River & Lake Erie Railroad. It afterwards made connections with the Little Miami Railroad at Springfield for Cincinnati. In 1850 an extension of the Mad River & Lake Erie was built from Springfield to Dayton, and connected with the Little Miami at Springfield. It formed the first all-rail route from Dayton to Cincinnati. The first engine for this road came to Dayton on a wagon in 1851 and was called the "Seneca." The first engineer in charge of her was John Hayes. The first engine to run between Dayton and Springfield was the "Erie," an engine with a single pair of driving wheels. This engine was in charge of Mr. Edward D. Smith, now retired from active service and a resident of Dayton. He brought the first regular train into Dayton. A conductor, called Fatty Brown, was in charge of the train.

The first officials of the Mad River & Lake Erie Railroad were E. F. Osborne, superintendent; T. P. Ford, master mechanic. The passenger engines on this road were the "Niagara," "Hudson," "St. Lawrence," and "Mississippi." They were built at Lowell, Mass. These four engines were all inside connected and were named after rivers. Other engines were named after towns and counties and were all outside connected and were bought by this road in 1853.

Here is a list of freight engines in service on this road. The "Enon," "Patterson," "Dayton," "Burwick." These four engines had 5 foot drivers and were built at Lowell, Mass. The "Lodi," "Belleview," "Carey," "Republic," "Tiffin," "Kenton," "Hancock," had 5 foot drivers and were built by the Rogers Locomotive Works. The "Champaign," "Hardin," "Clark" and "Huron" had 4½ ft. drivers, and were also built by the Rogers Locomotive Works. "Huntsville" and "Sandusky," ten-wheel engines with a 4½ ft. driver, were built at Portland, Me. The "Clyde," "Green," "Montgomery" and "Castalia," 4½ ft. drivers, and were built by the Rogers Locomotive Works. "Urbana" and "Bellefontaine" were 4½ ft. freight engines, and were built by the Harkness people of Cincinnati. "Springfield" and "Belle Center" were passenger engines with 5 ft. drivers and were also built by the Harkness people. "Oregon," "Portland," "West Liberty" and "Richland" were passenger engines with 5 ft. driving wheels and built at Portland, Me.

Some of the engineers on the Mad River & Lake Erie were E. M. Smith, George Bristol, Wm. Brown, John Carson, Joe Windol, Joe Lansdown, Joe Lease, Johnson, Levi Hancock, Pete Thomas, Pete Howe, John Smith, Dick Goodel, Comrod, Crane, George Lane and Israel Scranton. Mr. Scranton carried a large bullseye watch in his pocket and it was a standing joke to ask him the time. He also carried a rule, snuff box, pair of callipers in his pants pocket. The very first engines on this road had no hand rails or running boards on them. They had large spikes

OLD MASON ENGINE "MANSFIELD," 1876.

sticking out of the beams on the front of engines to catch cows and from this the name of cow-catcher originated.

OSCAR C. PEASE.

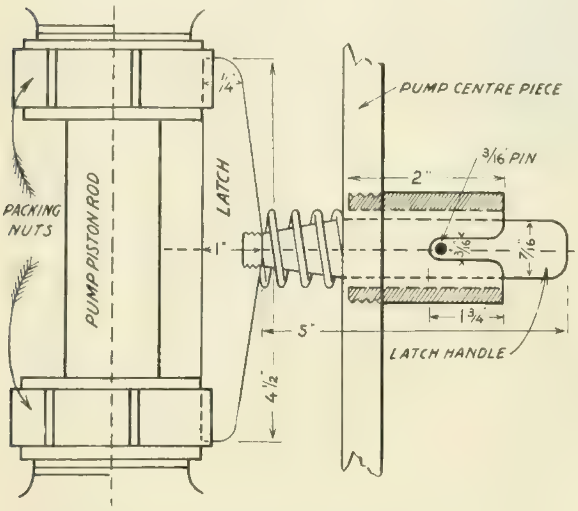
Springfield, Ohio.

Air Pump Nut Lock.

Editor:

I have here an air pump nut lock and I think it is the best lock I ever handled and I am sending you a sketch, as I think it may be of some advantage to your readers.

It consists of only three pieces latch, spring and a piece of ½ in. pipe. This piece of pipe is tapped into the centre



AIR PUMP NUT LOCK.

piece of pump on the back side, and the latch handle or stem comes through the pipe, with spring between latch and pump casting on the inside. The spring is made of 1-16 in. wire, 4 ins. pitch, 2 ins. long. The latch has a pin in the end, which drops into the slot when nuts are locked; and pulls out and turns half a turn and pin catches on end of pipe, and holds latch out while packing pump. When in place the latch fits into the square grooves in the packing nuts.

L. J. MALOY.

McCoy's, Tenn.

Good Results From a Line Check.

Editor:

I am glad to give to the readers of RAILWAY AND LOCOMOTIVE ENGINEERING something which has been acquired by experience and practice which are the true teachers. Two years ago last December I sent my engine to the shops for a general overhauling. After keeping her there some time she was returned in fair shape.

After running the engine about two months I found that it was necessary to grind in the right hand check valve. I may say that I do my own running repairs and I ground in the check valve myself, and can say that it was as tight as a bottle when I finished it. Two months later I had to grind in that check valve again. I then began to think things over and I took down the branch or delivery pipe where it connects to the Handcock inspirator. I found that the line check valve had been left out by carelessness or by orders from some one. I thought it might have been left out on purpose, as the inspirator worked a little firmer without it.

I ran the engine as it was for two months more, with the same results. At the end of that time I had to again grind in the check valve. This time I sent for the line check valve and got it and put it in place. I had ground in the boiler check three times in six months. It has now been eighteen months since I put in that line check valve and my boiler check is as tight as a bottle now. This seems to me to prove the value of the line check valve and I say keep the line checks in order and in place.

FRED NIHOOF.

White Sulphur Springs, W. Va.

Air Hardening Tools.

Editor:

When walking down between the rows of fires in our elegant, most up-to-date and famous smithy the other day, I heard some such remarks as these, "Look at this plase, Mr. Toot; Lord love ye, sure phwen I gets it hot and hits it, it flies apart like glass and phwen I thrys to bend it afther it gets cowld sure it breaks worse than glass and sure I don't know phat the devil to do wid it."

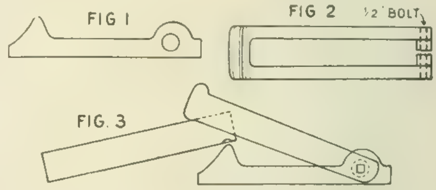
Such were the remarks addressed to me by an Irish tool smith, in sizing up the situation while making some mushet steel tools for axle lathes, for be it known that air hardening steel is almost universally used for this purpose, and as Pat had got hold of a bar unusually hard to work, he was at his wits' end to forge the tools and shape them, and by the way he is not the only smith that has fallen into the same trap, for this class of steel at times would try any one's patience when it is forged and shaped in the ordinary way.

Like all difficult jobs there is a way to work this kind of steel almost as easily as carbon steel, but patience and a knowledge of just what heat the steel will stand is the main point to keep in mind. One would think the high speed steels would have supplanted the air hardening ones, and so they have in other lines, but on axle turning the air hardening steels hold their own and is "The" steel seemingly, for the purpose, as they stand up to the work as well and cost far less than the high speed tools.

For intelligent shaping and working, a little study will convince any tool smith that ordinary measures are out of date with this steel. I know it showed me very quickly that I would have to change my tactics or the company would have to buy a job lot for me to practice on, before I could get my order filled for tools. It was always my custom to get right down to the whys and wherefores when in a hole like that, so I dug down in the recesses of my think tank and raked over the dormant "thunks" lying there, and I came to the conclusion that a longer heat would help some, and so it did.

The next evolution was accidentlly stumbled on and as good accidents are like the little girl, when they are good they are awfully good, this one was just what the "Doc" prescribed. I had run out of coke and was in a hurry, and as the helper had a lot of pine blocks by the forge for kindling I had him split them up for fuel until I could borrow some coke, but after working the first heat it was "to the divil wid coke, the timber for me," for the mushet worked very nearly as easily as common tool steel and seemed to hold heat much longer. Thereafter I used the pine entirely in heating this steel and had very few failures. Of course the steel must be heated very slowly and brought to a bright yellow for one-half the length of the whole tool.

The next move was to trim off with a chisel instead of shaping with a sledge. I found this much quicker and gave less grinding to be done. This pleased the axle men, for these tools are as hard to grind as to forge.



TOOT'S TOOL BENDER.

We had six double-end lathes, so mushet tools were on the bill of fare daily, and the next consideration was to get a tool for the steam hammer to bend them in and the tool shown in Figs. 1, 2 and 3 is the tool and the manner of bending. I bent them and chamfered them for right or left hand tools in one heat, and I call that pretty good for this steel, but the bending was done very gingerly and delicately, like making friends with a bench-legged bulldog. The rest was chisel work and smoothing with a flatter.

Patience, a good wood fire with slow blast and a long heat, is the secret for these tools, and if you try it, you will say "me too, Pete." T. TOOT.

St. Louis, Mo.

Old Haswell Duplex.

Editor:

In the December, 1907, issue of your valuable RAILWAY AND LOCOMOTIVE ENGINEERING Mr. Shaw says in his article on the "Shaw Balanced Engine," page 534, "Again the duplex has four valves, one for each cylinder, whereas the Shaw engine has but one valve for the two cylinders." Mr. Shaw's opinion is not correct. The old Haswell duplex had only two sets of valve gears for the four cylinders and only one valve for each set of cylinders. For this purpose the steam canals were crossed. KARL GOLSDORF,

R. R. Ober banral, E. M.

Vienna, Austria.

Proposed Change in Driving Boxes.

Editor:

Locomotive builders designing driving boxes and engine truck boxes hold to the uniform and interchangeable method so that either end can be placed towards the hub of the wheel. Presumably, the object the builders have in view in making the boxes uniform is to facilitate the dispatching of work in the erecting department, never considering that the engine will some day have to go in for general repairs. Then it will be necessary to shim the driving boxes and hubs of the wheels in order to eliminate the lateral motion between the driving wheels and boxes.

The writer would suggest a slight modification in the designing of driving and engine truck boxes, that would facilitate the despatching of an engine through the back shop at least the first time she was in for general repairs.

Make one end of the driving box longer than the other end. When the engine is new, place the shorter end next to the hub of the wheel and the longer end will be then inside the frame. The longer end can be made to suit the amount of wear for one year of the engine, or nearly so. If a box be designed to have one end five-eighths (5/8) of an inch longer than the other, both sides will eliminate one and one-quarter (1 1/4) in lateral motion which would be about the wear on mogul locomotives. Then for heavy consolidation locomotives the difference in the length can be increased as the wear is greater and the lateral motion correspondingly greater, especially on roads that are noted for short curves.

This method would be much more substantial than the process of shimming, as is now the general practice, and perhaps slightly more economical inasmuch as it would obviate the need of shimming boxes and hubs.

The proposed design of driving boxes would engage the driving box houses of present dimensions as the longer end of the box may project over the house and then the same journal bearing surface would be retained, but the cellars should be of corresponding length so that when the ends of the boxes are reversed the box and cellar will be against the hub.

JAMES FRANCIS.

Carbondale, Pa.

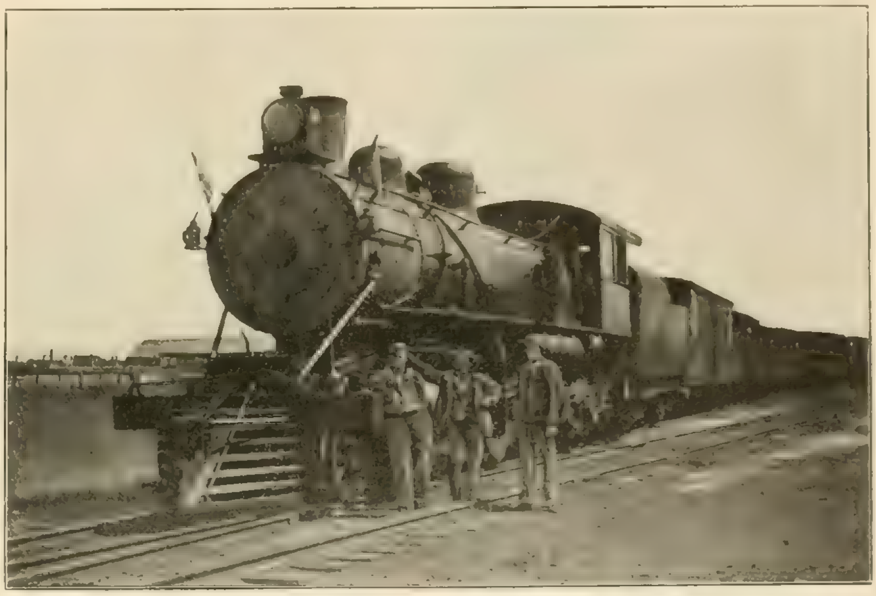
C., B. & Q. Freighter.

Editor:

I am sending you a picture of some Chicago, Burlington & Quincy Railroad power which you may be able to use in RAILWAY AND LOCOMOTIVE ENGINEERING. My cousin is the fireman and stands at the right of the group. The photograph was taken at McCook, Neb. Notice the difference in the height of cars.

E. C. ALLEN.

West Stockbridge, Mass.



C., B. & Q. FREIGHTER AND CREW.

Ferrocarril de Veracruz al Pacifico.

Editor:

Before leaving the land of the Montezuma and the extinct Aztec civilization, another brief account of railroading in the State of Veracruz may be of interest, spiced with sketches of pioneer life that will throw luster around the native Mexican in fighting for home and liberty. Foremost in its battles since the advent of the present generation stood the then young leader Porfirio Diaz, now President, and whose name will go down in history as one of the greatest men of the present age; he is an empire builder. His forefathers, for generations all native Indians, desperately fought for home and country against the foreign invader with an undaunted courage in defeat or victory. They went forth to battle against overwhelming numbers, ready to die if necessary. Who were they? Savage or civilized, the ruins of their ancient villages and temples is evidence that they were a prosperous, enlightened and civilized people.

The city of Veracruz is at present building a great railroad terminal which is estimated to cost $6,000,000. There will be a grand union depot with extensive terminals, all roads having equal rights. The Veracruz & Pacific, the Mexican Railway (the Queen's own), the Interoceanic and the Alvarado, the two latter narrow gauges. By the time the terminals are completed, the city will have paved streets, underground telegraph and telephone wires, extension of sewers, electric street railway to take the place of the present mule power, and be modern in every way, and it is hoped, will be as free from fever as Havana has been made under American methods of sanitation. All the above-mentioned roads do a thriving business at Veracruz; it is the gateway of Mexican ocean commerce. There are others, but this is the principal one, $30,000,000 having been expended in deepening the harbor and building docks and quays with solid walls of concrete. Its magnitude will thus be understood and appreciated. All the roads, in addition to other commercial business, bring in trains of tropical fruits that are transferred to fruit steamers direct from the cars and moved to Galveston, New Orleans and Mobile, where they are again transferred to the railroads and

sent to the different cities in the States as fast as the endurance of the iron horse can move them.

The State of Veracruz has a varied altitude from almost sea level at the city to 17,906 ft. at the top of Mount Orizaba, an extinct volcano; its majestic summit wears an everlasting mantle of snow. At the foot of this proud monument of nature can be found everything the tropics produce, while at its summit there is polar weather at all seasons. Prior to the conquest, this "Tierra Caliente," or warm earth, was peopled by two tribes of Indians, great warriors, who, according to a legend, killed an army of giants who lived among the numerous mountains. The descendants of the Indians yet live in this part of the country, peaceable, but maintaining their primitive dignity. Veracruz being long an important port, suffered from the navies of France and Spain, and was often assailed by pirates. The valor of the inhabitants on such occasions is worthy of a page in history, they giving up life in defence of their homes and families. A revolution in Texas in 1837 brought the American fleet to the port of Veracruz. Commodore Dallas, after a brief discussion with the Mexican commander, threatened to defend American interests by force if necessary. Twenty years after Commodore Dallas had pointed his guns on Veracruz, the great civilizer of nations, the railroad, started its onward march through rugged mountains, across vast gorges, weaving its web of steel over rivers and across ravines. The Mexican Railway was commenced in 1858 and completed fifteen years later, and carries the honor of being the first railroad (ferrocarril) to wend its way in the Mexican Republic, laying its bands of iron from the port of Veracruz to the city of Mexico. It is a grand monument to engineering skill and to British gold. It followed the old trail that Hernan Cortes with his band of followers took 400 years prior to its construction, when in his onward march from Veracruz to Mexico City he conquered the republic.

The principal shops of the Mexican Railway are at Orizaba. The Interoceanic Railway, one of the national lines, is a very important factor in the upbuilding of Veracruz. It is soon to be changed to standard gauge. It runs through several important cities all full of novel sights to the tourist, ancient ruins of Aztec skill and evidence of a high order of civilization. If we could only fathom the mysteries of the ancient races that evidently lived in this country 400 or 500 years ago, what wonderful tales we could unfold. A visit to the pyramids of the sun and moon, and other evidence of a long forgotten past along the line of this railroad would fill volumes, but I expect you will throw this among the scrap in the waste basket and say that you do not publish such ancient stuff, that the pages of RAILWAY AND LOCOMOTIVE ENGINEERING are filled with modern ideas and you want reports of modern improvements, but we are lately adopting ancient ideas and improvements for which their inventors were pronounced crazy half a century ago. The inventor of the Walschaerts gear was ridiculed in his time. Had he lived to-day he would be honored. Stirring up the forgotten past, if referred to in a spirit of fairness, will bring forth new aspirations and new ideas. Adios.

JAS. McDONOUGH,
S. M. P. Veracruz & Pacific Ry.
Tierra Blanca, Mex.

Master Boiler Makers.

Editor:

The attention of our board of officers has been called to the fact that some of our friends of the mechanical papers are overlooking the fact that the International Railway and Master Steam Boiler Makers' Associations have consolidated and there is now only one association in the field. It is the International Master Boiler Makers' Association, and we therefore suggest, if consistent with your rules, that announcement of this fact be made, together with list of officers as given on this letterhead. This would serve to correct a wrong impression. I may also add the fact that the next convention will be held in Detroit, May 26, 27 and 28, 1908.

HARRY D. VOUGHT,
New York. Secretary.

[Below is the list of officers of the association referred to by Mr. Vought.—Ed.]: President, George Wagstaff, Supervisor of Boilermakers, New York Central Lines, Buffalo, N. Y. Vice-Presidents, First, E. S. Fitzsimmons, M. M., Erie R. R., Galion, O.; Second, E. J. Hennessy, N. Y. C. & H. R., Depew, N. Y.; Third, W. M. Wilson, Blacksmith Inspector, I. C. R. R., Chicago, Ill.; Fourth, E. W. Rogers, F. B. M., Cooke Works, American Locomotive Company, Paterson, N. J.; Fifth, Peter F. Flavin, Standard Railway Company, Nat. Bank of Commerce Bldg., Box 75, St. Louis, Mo. Executive Committee—G. W. Bennett, N. Y. C. & H. R., West Albany, N. Y.; D. G. Foley, G. F. B. of the I., D. & H., Green Island, N. Y.; P. J. Conrath, G. F. B. of the I., M. P. R. R., Seventh and Market streets, St. Louis, Mo.; A. N. Lucas, F. B. M. of the C. M. & St. P., Milwaukee, Wis.; James J. Fletcher, F. B. M., Canadian Foundry and Machine Co., 610 Bathurst street, Toronto, Ont. Secretary, Harry D. Vought, 62 Liberty street, New York City. Treasurer, Frank Gray, F. B. M. of the C. & A. R. R., 806 N. Madison street, Bloomington, Ill.

Curious Flow of Steam Explained.

Editor:

Reading, in your January issue, the article on "A Curious Flow of Steam," leads me to relate my experience.

About three years ago, an engine on the Rockland Railroad began acting in the manner described by your correspondent. When the boiler was filled up for the night, a strong flow of steam would appear at the cylinder cocks, and would keep up for about a half an hour. Lately, we had a great deal of trouble with iron scales plugging the cylinder cocks up, or getting under the cylinder cock valves and preventing them from closing. Finally, on the day before Christmas, while this engine was on the road, running light, the dry pipe collapsed, which made things interesting for a few minutes. After reducing the steam pressure so that the engine could be handled with the reverse lever, she was brought home under her own steam; or, I might say more correctly, under her own water; as more water than steam went out through the ruptured dry pipe.

From my experience in this case, I should advise your correspondent to have the dry pipe of his engine examined for leaks.

Your half-tone engravings of the Mason, New York & Manhattan Beach engines are very interesting to me and carry me back to the "good old days" when I was running on the New York & Sea Beach, which ran parallel to Manhattan Beach, from Bay Ridge to Bath Junction. This piece of track was the scene of many an exciting race between the trains of these rival railroads. The rules prohibited racing, but if a man was ahead there was no rule which prevented him from just keeping ahead. As the pictures show, these engines were equipped with the Walchaerts valve gear (the "Monkey Motion," the Sea Beach boys called it) and the tumbling shaft passed through the bell frame. The engineer had to stretch his neck to peek over it, or else crouch down and look under it. But they were the easiest riding engines ever made; as both engine and truck frame turned on a centre casting.

Mentioning racing reminds me of one summer when the No. 4 on the Sea Beach beat the No. 60 on the Manhattan Beach so often that the 60's engineer, Jack Yorke, came over to investigate. Well, it just happened that the No. 4's steam gauge had gotten out of order that day, and the pointer was almost around to the pin. Yorke climbed up on the 4, took a look at the gauge, and said to

Dan Hummer, "You fellows carry a pretty good pressure over here."

"Oh, thunder!" said Dan, "that's only been around twice." Yorke immediately left for his own side of the fence, fully satisfied that he had found why the 60 could not beat the 4.

E. W. Gregory.

Hoffmanville, Md.

Re Slipping Shut Off.

Editor:

I have been a reader of your valuable paper for years and have seen all correspondence and your notes on the above subject, and as a good illustration of what takes place came under my notice, when running an engine with cylinders 15 x 20 ins. and 3-ft. drivers fitted with American balance valves on a regular run, I send it to you. The track at one place was covered with a trailing green grass for about 200 yards. Running over this early in the mornings, shut off, the engine seemed to ride rough, as if slipping. Being delayed one night I ran over this place after daylight, and when approaching it I got down on the step. The side rods and wheels were a regular blur, but as soon as the engine ran on to the grass the driving wheels slowed up, and not only the rods and wheels but the shape of set screws, split pins, cotters, corks, nuts, could be plainly seen and the slipping sensation was felt. I remained on step until the grass portion was past; then the drivers quickened up again until the counterweights and spokes seemed all alike and the side rods a blur as when I first saw them before running on to grass part. The speed of driving wheels when slipping seemed to be uniform, and I think would have only moved the train about 5 miles per hour, but the train was running at least 20 miles per hour at the time.

I consider the slipping is caused by the compression in the cylinders and adhesion between the drivers and rails being reduced owing to the slippery condition of the rails with the crushed grass sap and dew. That is there was not enough adhesion between drivers and rails to overcome compression and friction of moving parts in this engine with her small drivers, and the piston speed would be high at 20 miles per hour.

I consider that with unbalanced slide valves the engine may have slipped, but the wheels would not run as slow as they did with the American balance valves, which, in my opinion, causes more compression than unbalanced D slide valves, for since the balance valves have been put on the engines do not drift as free as they did previously. This engine has been overhauled since I ran her and no bent axles or crank pins were found

E. E. R.

Rockhampton, Australia.

[The question of slipping shut off has been very thoroughly threshed out in our paper and we will have to declare the discussion now closed. Our readers are referred to page 489 of our November, 1907, issue, in which references to previous articles are noted and explanation given.—Ed.]

The Growing West.

Apropos of the growth of new towns in the west, a locomotive engineer relates the following, says the *Epworth Era*:

One day I was driving my engine across the prairie when suddenly a considerable town loomed up ahead where nothing had showed up the day before.

"What town's this?" says I to my fireman.

"Dunno," says Bill, "it wasn't here when we went over the road yesterday."

"Well, I slowed down, and directly we pulled into the station, where over five hundred people were waiting on the platform to see the first train come in.

The conductor came along up front and says to me:

"Jim, first thing we know we'll be running by some important place. Get this town down on your list and I'll put a brakeman on the rear platform to watch out for towns that spring up after the train gets by!"

The Petticoat Pipe.

The petticoat pipe in some form has for years been a feature of American locomotive practice and is more or less of a necessity in view of the limited dimensions of the smoke stack on the modern locomotive. It serves in a great measure the same purpose as the tubes of an injector do in inducing the flow of water. The draught of air passing through the flues is led into the bell mouth of the petticoat pipe by the action of the exhaust, and it is essential that in the event of the petticoat pipe being separate from the smoke stack its size at the upper end should be proportionate to the size of the smoke stack, and it should be set exactly central with the exhaust nozzle and smoke stack. The effect of the petticoat pipe in regulating the draught in the smoke box is coincident with the deflector sheet, and both are intended to create a uniformity of draught through the flues, so that the heat should be equally distributed over the entire area occupied by the flues.

Exact rules cannot be laid down for the location of the petticoat pipe. The distance from the top of the exhaust pipe to the lower edge of the petticoat pipe is usually made about equal to the diameter of the smoke stack. A slight change of the height of the pipe has often a considerable effect on the draught and consequently in the steaming qualities of the engine. The uniform appearance of the flues is the best test of the uniformity of draught. Where the draught is strongest the flues are the cleanest, and if flues are partially choked with soot or ashes it is conclusive proof that the draught has not been sufficiently strong in that locality to keep them clean. Generally speaking, if the petticoat pipe is set too high, the draught will be strongest in the lower flues, and if the pipe is set too low the upper flues will receive the strongest amount of draught. In view of these facts, very little experimenting should be necessary to obtain the best working height at which the petticoat pipe should be kept.

It need hardly be stated that in the case of badly proportioned or badly set petticoat pipes the effect on the fire is of the most pernicious kind. In cases where the fire is burned rapidly out in some portion of the fire box it is safe to assume that the cause of the trouble is in the petticoat pipe, and a slight change of position in the pipe will show some variation in the fire box. The petticoat pipe has long been in service on American locomotives, but it is only in recent years that it is being slowly applied on some of the European railways. The tendency on American locomotives is to make the petticoat pipe a mere extension of the smoke stack projecting towards the center of the smoke box and doubtless this method will eventually become standard.

General Foremen's Association.

We are requested to announce that it is the intention of the officers of the International Railway General Foremen's Association to make the next convention a great success. In order to contribute to this end all members who have not yet paid their annual dues, should do so by March 1st next at the very latest. Prompt attention to this matter will be greatly appreciated by the executive committee, who are working hard with the determination of making the convention in Chicago, May 25 to 29, more than usually attractive. The committee is looking forward to the next meeting of the association as likely to be the most successful ever held. Arrangements have been made with many of the prominent supply houses for an exhibition and everything possible will be done for the convenience and comfort of the members who attend, but to carry out the enterprise so as to make an assured success of it, the members must help.

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The Permissive Idea.

Within the past year there has been a great deal of activity in the signal departments of our leading railways. This activity has not only been in the direction of new installations of block signals, but it has extended to that important part of live railroad operation which has to deal with the question of whether or not the signals when set up and worked are obeyed by the men on the road.

There was an article published in the January number of the *Atlantic Monthly* in which the writer gives what are called the "Confessions of a Railroad Signalman." In this article one point is strongly insisted on by the author, and it is this: He says the idea that rules and signal indications are permissive and not necessarily positive has in some way got into the heads of railroad employees. He states the case something like this, and the meaning of his contention is plain: A flagman will protect his train to the very letter of the rule if he finds it manifestly necessary, but when in his opinion it is not he takes chances. Locomotive engineers, he says, constantly run past caution signals without any reduction in speed, provided the track ahead is seen to be clear.

Dealing with this point, the writer says: "Here we tackle the very heart of the matter, for in so far as the rules and common sense are concerned, it should not make a particle of difference to the engineman whether the track ahead is or is not known to be clear of trains; his instructions call for careful running, and by no possible interpretation or juggling with words can cautious running or running under control be taken to mean running at full speed. Yet in the way I have indicated the cancer of a very dangerous habit has been allowed to grow into the American system of managing trains. This wrong interpretation of the word caution by enginemen and others has without a shadow of doubt during the past few years cost the corporations thousands upon thousands of dollars and multitudes of human lives. For if railroad managers labor under the delusion that enginemen can run *cautiously at full speed* when the track is clear and avoid disaster when from unforeseen reasons another train happens to be on the same section, they are very much mistaken."

In this way it appears that what may be called the "right of private judgment" has come to be exercised by railroad employees and rules are followed and signal indications are obeyed only when they commend themselves to the judgment of the man or men concerned. There is among many railroad men an undefined belief that rules are made more for the purpose of shielding the company in case of a civil action in the courts, than for the guidance of employees on the road. This feeling has probably been justified on certain roads, in the past, and where the feeling has existed, either rightly or wrongly, it has tended to foster the growth of the "permissive" interpretation, of which the writer in the *Atlantic Monthly* speaks.

The growth of the permissive idea with regard to rules and regulations is nine times out of ten the fault of the operating officials. Like master, like man is a maxim true in railroad operation as it is in other branches of human activity, and it is a fair judgment on the discipline of any road to say that wherever a dangerous practice has been allowed to take root or persistent carelessness has developed, the head of the department is the one who is primarily responsible, and he is the original chancetaker.

There is one significant fact which cannot be ignored even by those who persist in believing that rules are made for the protection of corporations. It cannot be argued that a signal indication is simply intended to protect a company when brought into court. It may do so, of course, but the primary intention made manifest by the installation, maintenance and working of a block signal system is for the positive government of trains on the road. This view of the case is supported by the fact that on many of our important lines a system of what has been called surprise checking has been introduced, and in the published returns, now before us, of two roads the results have been found highly satisfactory. The so-called surprise check system also brings into prominence the fact that the daily responsibility of operating railroad officials for what takes place on the road is being more and more recognized and insisted on. The superintendent who does not superintend has been found to be one of the most expensive items in the whole railroad service.

The writer of the *Atlantic Monthly* article says that, "There is practically no out-on-the-road supervision on American railroads." The surprise checking system appears to us to be a very real out on the road test, and indicates that the railway companies which have spent large sums for the installation of block signal systems intend to have them made effective in every day life on the road and with little or no idea of just having a legal defence when brought into court. On the Union and Southern Pacific the percentage of efficiency of the men for the month of November, 1907, was 98.7 per cent., and on those roads there is an average of forty-five surprise tests every day in the year, made for the purpose of ascertaining how closely signal indications are observed. On the Pennsylvania the record for the month of October last shows an efficiency of 98.8 per cent. of the tests made.

These figures, even if they constitute banner months for the respective roads making the tests, yet show that railroad companies are not indifferent to the performance of duty out on the road, and the results obtained also indicate that a healthy and manly intention to "play the game according to the rules" is making headway among all the ranks of railroad men.

Satisfactory intentions do not, however, constitute even practical perfection, and there is much to be done before any of us can rest content. The "Confessions of a Signalman" is an important contribution to the literature of the subject from the fact that it puts a finger definitely down on the bad effects which must inevitably flow from the "permissive" interpretation of rules or signal indications. No one denies that there has been too much of it in the past and if we are to guarantee even a reasonable amount of safety in railroad operation to the traveling public, it is the paramount duty of every man, whether officer or private, in the railroad army to "set his face as flint" against the chancetaker and to play the game squarely and always according to the rules.

Fellow Servant Iniquity.

What was the most important measure for railroad employes ever passed by the United States Congresses was that which seemed to end the "fellow servant" antiquated iniquity, and made railroad companies liable for accidents to their men due to any species of careless or neglect, no matter who the guilty parties were. It was not to the credit of railroad companies that they fought this eminently fair law to what might be called the last ditch. That ditch is the Supreme Court of the United States, which may always be depended upon to decide against labor when a suit comes up where labor and capital are in conflict.

Under the combined influence of great railroad corporations and capitalistic power the sympathetic aristocrats of the Supreme Court of the United States have decided that the act of Congress known as the employers' liability law is not in accordance with the Constitution of the United States because it goes beyond the bounds permitted in the regulation of interstate commerce, was the conclusion reached by the Supreme Court of the United States in deciding two damage cases coming to the court from the federal courts of Kentucky and Tennessee which were brought under the provision of the law. The decision was announced by Justice White, the court standing five to four against the law.

There were two cases before the court, involving the question of the validity of the law, one of them being the case of Damselle Howard, administratrix of her husband, William Howard, a locomotive fireman, who was killed in an accident on the Illinois Central road near Memphis, and the other that of N. C. Brooks, administratrix and mother of Morris S. Brooks, a fireman, who was killed on the Southern Pacific road in Nevada.

There was no question concerning the responsibility of the railroad companies for the accidents which resulted from the carelessness of the employets. The only question was the right of Congress to make laws for the protection of persons engaged operating trains doing interstate work. The Supreme Court made the far fetched distinction that the right given by the Constitution to regulate commerce between States did not include the right to protect the lives of employes engaged in such.

The law was passed owing to immense pressure put upon legislators by the combined demand of railroad organizations.

In his message in 1906 President Roosevelt referred to the law as an excellent one, but said it did not go far enough. He added: "Neither the federal law nor, so far as I am informed, the state laws dealing with the question of employers' liability are sufficiently thoroughgoing."

The combined power of the railroad employes which compelled a reluctant Congress to pass the Railroad Companies Liability law ought to be potent enough to have a constitutional amendment passed defining the responsibility of railroads towards the safety of persons engaged in interstate commerce. To the railroad labor organizations we say get busy and lose no time.

Many Train Accidents.

Accidents to trains on the railroads of the United States continue to occur in such large numbers, says the twenty-first annual report of the Interstate Commerce Commission, that the record, as has been repeatedly declared by conservative judges, is a worldwide reproach to the railroad profession in America. The total of casualties have largely increased year by year. The total of passengers killed in train accidents (nearly all of them in either a collision or a derailment) aggregates for four years 1,212, or an average of 303 a year. It is the notable disasters which alarm the public and which give rise to demands for the application of remedial measures by the government. The most startling cases are collisions, and the collisions are in a large majority of instances due to certain defects in management, for which the most comprehensive remedy is the block system. This commission has, therefore, recommended repeatedly the statutory enforcement of the use of the block system on all railroads doing interstate passenger traffic, and now makes the same recommendation again. The collision horror continues to be a crying evil. There has, indeed, been a steady increase in the use of the block system on the railroads of the country, but in the great activity in passenger travel of the last few years, which has been rapidly growing year by year, the passenger business of non-block signaled lines has increased with that of others, and many passengers have been killed in collision. In the few serious collisions that have occurred on block signalled lines the management and discipline—in every case, with possibly one exception—have been shown to be glaringly faulty, demanding government investigation. This demand is urgent, as has been set forth in our previous reports.

The Congress has taken no action on the recommendations here referred to, except to receive and print a bill presented by the Hon. John J. Esch, of Wisconsin, calling for the gradual introduction of the block system on those railroads which are subject to the act to regulate commerce.

It will undoubtedly be fair and just to require the railroads to adopt the block system in a shorter period of time than was contemplated when the Esch bill was drawn. In consequence of the discussion of the subject by the commission, and of the introduction of the Esch bill, and for other reasons, some roads have made nearly or quite as rapid progress in the introduction of block signals as would have been required by the bill had it been made a law. It is believed, therefore, that no injustice will be done if railroads, or parts of railroads, having passenger receipts of $1,500 a mile per annum are required to be brought under the block system in two years. Railroads having total receipts from all traffic of $3,000 a mile per annum should be subject to the same requirements.

Carnegie Vanquishes Crane.

It is always a dangerous thing for any person to generalize on the effects of particular education or training upon the future career of one striving to make his way in the world. In an address before the Western Railway Club Mr. R. T. Crane went out of his way to disparage technical education and to argue that technically trained mechanics are seldom a success in their calling or profession.

We have enjoyed many opportunities of comparing the work and performance of technically trained engineers with that of the purely practically trained man and we certainly take exception to the position assumed by Mr. Crane. There are technically trained mechanical graduates who have no ambition to excel in their profession and they sink down into draughtsmen or common workmen. There are also thousands of good mechanics whose ambition never rises above the ability to earn the first class pay of a mechanic, men who never acquire sufficient knowledge to recommend them for the position of foreman. The callous careless college graduate and the mechanic whose thoughts are concentrated upon quitting time are of the same psychological species. But there are other species of educated engineers and of self-helping mechanics. The college graduate who receives a job in a shop, dons overalls and goes to work doing his best to learn the business without fear or favor, will learn the manipulation part better than an ordinary apprentice and he will have useful scientific knowledge added to his skill and shop experience. His rival is the trained mechanic who studies the science of his business and by degrees becomes an educated mechanic or engineer. As a rule the educated mechanic receives first consideration when a higher position is vacant, but it is doubtful if he is more successful than the technically trained man.

In his antipathy to technical education Mr. Crane declared that had double the money that Dr. Andrew Carnegie has spent on technical education been thrown

into the sea the country would be better off.

While preparing his address Mr. Crane wrote to Mr. Carnegie, asking him a number of questions apropos of the above statements and his present occupation of building technological schools. Three days after the address was delivered Mr. Carnegie wrote him the following letter:

New York, Dec. 20, 1907.

My Dear Mr. Crane:

I have little time to devote to the defense of technical education. I do not think it needs any. It is speaking for itself, and will speak for itself, and even you will be satisfied by and by that we are on the right path.

You ask me four questions. To the first I answer that when I started business I did not know of one technically educated mechanic, but several families in Pittsburgh were sending their young men to Troy, and especially to Boston. One of them happened to be a relative, and he has made a great success, and is a partner now in one of the leading firms for special steels. I do not believe he would have achieved this so rapidly if it had not been for his superior education. If I were in business to-day the young man I should take into my service would be the most highly educated mechanic.

This answers all your four questions, and I should like to ask you one question in return. The apprenticeship system is a thing of the past; what do you propose as a substitute? The best one and the one better than the original is to give instruction to young men in technical schools. I asked two high authorities how they would answer your questions, and beg to inclose their replies, which please return.

Hoping all of this will be of use to you and with kind greetings of the season, I am, always your friend,

Andrew Carnegie.

Investigation of Accidents.

The investigation of collisions, derailments and other serious accidents on railroads by competent experts, says the Annual Report of the Interstate Commerce Commission is a matter deserving the careful attention of the Congress. A recommendation to authorize such investigation has been made in previous reports and the same recommendation is now again made. Some of the States of the Union now conduct expert investigations of the more serious railroad accidents, but in many States there is no authoritative and expert investigation whatever, except as the facts of accidents may come before the courts when suits are brought against railroad companies for damages.

All persons traveling on railroads and all men employed on engines or trains are interested in this matter. A railroad manager may have reasons, possibly—in some cases from his own standpoint good ones—for concealing the facts of a wreck; but it is to the public interest that they may be disclosed, as a warning to others and to throw light on means of prevention.

The daily and technical press have both endorsed the recommendations which have been made by this commission. It is universally recognized that the causes of railroad accidents are often complicated and obscure and the responsibility difficult to define. A cross-examination and sifting of evidence is necessary in nearly every important case in order to bring out the truth and to rightly apportion the blame. Investigation by officers appointed by the Board of Trade has been a powerful lever in the improvement of the management of the railroads of Great Britain, the reports of the investigating officers being published and widely read.

From reports made to the commission by its inspectors of safety appliances, the general condition of railway equipment appears to be much better than it was a year ago. Somewhat fewer cars were inspected during the last year, the number being 271,617 for 1906, and 242,881 for 1907. This decrease is explained by the fact that calls upon inspectors to investigate complaints of violation of the law were more numerous than in former years and that they were also engaged more frequently as witnesses in court. The time that could be devoted to regular inspections has thus been curtailed. A gratifying feature of these inspection reports is the marked decrease in the number of observed defects. For each 1,000 cars inspected in 1906 there were 139.34 defects, while in 1907 there were but 94.14 defects per 1,000 cars inspected.

The number of casualties to railway employes is constantly increasing. Several causes contribute to this undesirable condition, such as increase in the number of men employed and more exacting conditions of traffic. It is observable, however, that notwithstanding the general increase in casualties the accidents to trainmen due to coupling and uncoupling cars are constantly decreasing. This result proves the wisdom of Congress in enacting the safety appliance law and justifies the endeavor of the government to secure its proper enforcement.

The whole tone of the report of the Interstate Commerce Commission is to emphasize the need for safe railroad operation. We are efficient in other ways. Safety should be paramount.

Locomotive Engineering in 1907.

The railways of this country alone, says the author of an article reviewing in the London *Times* the engineering progress of the year, continues to build large numbers of eight-wheeled engines of the 4-4-0 type, the North-Western, Midland, and Great Eastern Railways being the chief adherents to the continued use of such locomotives both for the fast and heavy main line passenger work. Such engines regularly haul loads up to 350 tons for long distances at speeds of over 50 miles an hour. But, in remarking on the fact that engines of this type continue to find so much favor with British locomotive engineers, it must not be overlooked that increased boiler capacity has made this class a far more efficient type of engine than it was a few years since. The main advantages claimed for such engines are their simplicity in construction and cheapness, both in first cost and in maintenance.

An important development in locomotive engineering on this side of the Atlantic has been the introduction of the Pacific, or 4-6-2, type engines on European railways. The first Continental line to adopt this type was the Paris-Orleans Railway, and now large numbers of these engines are being built both in French and German locomotive works. It will be remembered that the chief mechanical engineer of one of our railways, after experimenting with Atlantic type engines, decided early in the current year to revert to six-coupled engines as a standard, it being found that the adhesion of four-coupled engines was insufficient for modern work. The first British engine of 4-6-2 class is now undergoing its trial runs and will shortly be placed in regular service on the Great Western Railway.

British railways for the most part still continue to employ either six- or eight-coupled engines for goods and mineral traffic. On the London and North-Western Railway, however, some of the eight-wheeled goods engines of Mr. Webb's design have been converted to 2-8-0 type engines and fitted with larger boilers. Although Continental goods trains are not generally heavier than those in this country, most of the modern goods engines are now fitted with either two or four-wheeled leading trucks and with either eight or ten coupled wheels. It is said, however, that a ten-wheeled coupled engine may shortly be tried experimentally on an English line.

One of the most striking tendencies in British locomotive design has been the great increase in the size and power of tank locomotives and the extended use of these engines for moderately

long distance passenger services. It will be remembered that one of the inspecting officers of the Board of Trade some few years ago questioned the safety of tank engines on the ground of undue oscillation, but statistics were forthcoming which proved conclusively that no case against the employment of tank engines could be made out on that ground. Probably the satisfactory settlement of this point of contention has not a little to do with the extended use of tank engines which has lately taken place. The Midland Railway has introduced for its heaviest suburban passenger services around manufacturing centres in the Midlands and the North of England and for hauling slower main line trains one of the most powerful types of tank engines ever built in this country. It has six coupled wheels and a trailing bogie. The tanks extend along both sides of the boiler right up to the smoke box, thus enabling the whole of the bunker to be used for coal storage. A somewhat similar type of tank engine is now largely used on the Great Northern Railway, but in this instance there is only one pair of trailing wheels under the bunker.

It would appear that the simple engine is more than holding its own in British locomotive practice, which contrasts strongly with both Continental and American practice. Nevertheless, some progress has been made in locomotive compounding in this country during the past year. For instance, a large number of compound goods engines have been built for the Lancashire and Yorkshire Railway. In this type separate axles are driven by the high-pressure and low-pressure cylinders respectively, but only two sets of valve mechanism are used for actuating the four slide valves. Three-cylinder compound locomotives continue to be extensively used on the Midland Railway and to a less extent on the Great Central. It is stated, however, that, although excellent work is done by these engines, their best performances are consistently equalled by simple engines of similar design and size. It is admitted that the third cylinder is useful in cases of extra stress in working, but that the economy in fuel consumption effected thereby does not recompense for the extra cost in building. Four-cylinder, high-pressure, simple engines continue to be used on the London and South-Western and Great Western Railways. On the latest engines of this type on the former railway the cylinders have been enlarged by half an inch in diameter and two inches in stroke. The dimensions of the four cylinders are now 16½ in. by 26 in. A water-tube firebox is used, together with feed water heater, and it is stated that with the great boiler power provided on these engines no difficulty is experienced in steaming to the extra capacity of the larger cylinders.

The use of superheated steam on locomotives, which is said to have given such satisfactory results on the Prussian State railways and in Canada, has made little progress in this country. The Lancashire and Yorkshire Railway is, however, now conducting a series of trials with the Schmidt superheating apparatus, This apparatus is being extensively adopted in Belgium, Italy, and Sweden, and, it is said, would give good results in this country, particularly on those lines using four-cylinder simple engines. In the United States the practice of superheating steam for locomotives has as yet made comparatively little progress.

British locomotive builders have been kept busy with large orders for locomotives from colonial, Indian, and South American lines. Both passenger and freight engines of the most advanced types have been supplied to the leading Indian and Argentine lines. In fact, the locomotive equipment of these lines will soon hardly be excelled by any country in the world. Up to the end of November the aggregate value of the engines exported was £3,353,139, as compared with £2,580,330 and £2,146,282 for the similar periods of 1906 and 1905.

Book Notices.

Proceedings of the Traveling Engineers' Association. Edited by W. O. Thompson, Sec., Buffalo, N. Y. 350 pages. Cloth. $1.50.

The annual report of the proceedings of the Traveling Engineers' Association which met at Chicago in September last is just issued and forms a very important contribution to the railway literature of the year. The association has been growing in numbers and its meetings have correspondingly risen in importance every year during the fifteen years of its existence. We presented on the pages of Railway and Locomotive Engineering reports of the most striking features of the meeting, but the volume before us presents the completed report with a degree of fulness which a periodical could not be expected to present. We commend the volume to the warm attention of all who are interested in railroad work. All of the leading problems in connection with the mechanical appliances used on railways are treated in a masterly way. The debates are interesting from the fact that the men taking part in them were nearly all men of wide experience and accomplished in the graces of oratory as well as in the sterner qualities of railroad engineering. Mr. Thompson, the worthy and accomplished secretary, sustains his well-earned reputation as an able and painstaking editor.

Proceedings of the Master Car and Locomotive Painters' Association of the United States and Canada. Published for the Association. 125 pages. Cloth.

The proceedings of the annual conventions of this important association have come to be looked upon as valuable contributions to the technical literature of our time. The present publication contains the report of the thirty-eighth meeting of the association and worthily sustains the fine instructive and educational features that have characterized the preceding publications. These published reports help to build up a better and more scientific knowledge of an important profession, and the meeting at St. Paul, Minn., last September will long be remembered as among the most notable held under the auspices of the association.

Specifications and Contracts. By J. A. Waddell, C. E., together with notes on the law of contracts, by John C. Wait, M.C.E. Published by the Engineering News Company, New York. 174 pages. Cloth. Price $1.00.

This is an excellent work, including as it does a series of lectures delivered by Dr. Waddell on a subject on which he is universally recognized as one of the leading living exponents. The lectures are ably supplemented by Mr. Wait, an eminent attorney and author, and the whole forms a textbook which undoubtedly will take its place in engineering schools. The "examples" given are sufficient in themselves to perfect young engineers in the writing of technical documents. This is a matter of great importance in engineering practice, and it is fortunate that in one volume all the complex legal forms and methods are condensed and presented in a way that is completely capable of adaptation to any construction contract.

Machine Design. By Charles L. Griffin, S. B. Published by the American School of Correspondence, Chicago. 186 pages, with numerous illustrations. Flexible cloth. Price $1.50.

The practical side of machine design is treated by an accomplished expert, and is based on a careful study of the needs that have arisen in engineering and scientific fields. The work is complete in itself, and is adapted for home study. The paper and presswork are of the best. The binding is in red art vellum de luxe.

There is a great deal of enthusiasm manifested in some quarters about the introduction of the "pay-as-you-enter" car, such as they have in Montreal, Canada. What the public would like to see introduced is a "seat-as-you-pay" car.

N. Y. C. Apprentices.

In dealing with the education of apprentices the New York Central Lines have taken a very advanced position, and one that is not only of advantage to the young men who are employed in the various shops, but is of material advantage to the company. Writing on this important subject Mr. H. S. Rauch, drawing instructor at Oswego, N. Y., says:

N. Y. C. APPRENTICE CLASS, OSWEGO, N. Y.

"The Drawing Class at Oswego was started January 5, 1904, under the direction of Mr. W. O. Thompson, who was at that time division superintendent of motive power. Class meetings were held once each week from 5 P. M. to 7 P. M. Mechanical drawing was taught; the studies of parts embraced such drawings as apprentices come in contact with in the shops. The class was conducted along these lines until November, 1906, when the apprentice class at Oswego became a part of the New York Central Lines with the apprentice system under the direction of Mr. C. W. Cross, superintendent, and Mr. W. B. Russell, assistant superintendent of apprentices. At this time the courses were changed to conform with the standard educational courses of the New York Central Lines, which includes drawing from models with the aid of a partially drawn print, and a set of practical shop problems in arithmetical form; these problems are so arranged that a student can advance as fast as he sees fit and is not held back by the slower pupils.

The models which are used in the drawing courses are car and locomotive parts, tools and tool jigs; in fact, all parts of machinery which will be likely to come under the observation of a mechanic in the regular order of shop work. We have twenty-three apprentices at Oswego, divided into two classes; each class is given four hours instruction each week, attending two sessions of two hours each. Class No. 1 meets Tuesday and Thursday from 7 to 9 A. M., and Class No. 2 meets Wednesday and Friday at the same hours. Work on the shop problems is done at home, and handed in during the class session for the instructor to check up; if correct, they are filed until a certain number are on hand, when they are handed back to the apprentice to become his property; if they are not correct, they are given back for another trial with such explanation as is necessary.

INSTRUCTION OF APPRENTICE CLASS AT OSWEGO, N. Y.

The company furnishes a room, drawing board, pencils, paper, 1-45 deg. triangle, one 30 x 60 deg. triangle, 1 triangular boxwood scale, curves, protractors, etc. These are loaned to the apprentices until their apprenticeship expires, when they become their own property. I send you photographs of both classes. I think this covers the ground quite thoroughly. Any other matters pertaining to the general organization can be obtained from Mr. Cross or Mr. Russell.

Aids to Self Help.

Owing to the growing strictness of railroad companies in requiring their trainmen to pass examinations before being promoted there is a constant demand for aids to acquiring the information necessary to the successful passing of examinations. No publication ever offered to railroad men has been so helpful as the "Railroad Men's Catechism," published by the Angus Sinclair Company, price one dollar.

When railroad men go through the mental drill that enables them to pass an examination they generally begin to look for books of an advanced character. To such men we commend the study of "Twentieth Century Locomotives," a book that has become a great favorite with railroad mechanical engineers. This book is full of advanced information concerning the construction and repairing of railroad rolling stock and contains more valuable information than any book of its size.

Correspondence School

Controller Handle Button.

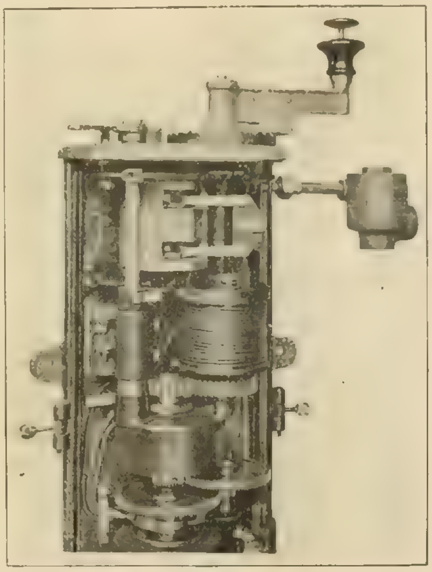
By W. B. Kouwenhoven.

There aré two important automatic protective devices on the trains of the New York Subway, the button on the controller handle and a device for opening the circuit-breakers in case of the train breaking in two. The system of control employed on the Subway trains is of the same type of control as that used on the Manhattan elevated railway, both roads belonging to the Interborough system. This type was described in our December, 1907, issue. There is only one important difference—the type M control used on the Subway is equipped with a device which makes its operation automatic. This makes it possible for a Subway motorman to throw his controller handle to the full multiple position at the start, and the contactors will automatically notch themselves up to that position.

The button on the controller handle, or the "dead man's handle" as it is sometimes called, performs two functions, one is to complete the train line circuits and the other is to operate an emergency brake attachment. For sake of clearness we may say that in this article the circuits that supply electric power to the electro-magnets of the contactors throughout the train are referred to as the train line or train line circuits, and the system of piping that extends through the train for the air brake system is referred to as the train pipe.

When the motorman presses down the button on the controller handle it closes two contacts inside the controller drum, which complete the circuits for the train line, and thus supplies electric energy to the electro-magnets of the contactors. These contactors handle the heavy current supplied to the motors. If, while the train is in operation, the motorman should release his grip on the controller handle, the button would immediately rise and thus open the two contacts referred to above. These contacts being open, cut off the current which flows to the solenoids that operates the contactors, and they open, thus cutting off the supply of current to the motors. The train, however, would coast ahead if it was not for the emergency brake valve, which here comes into play.

The emergency brake attachment consists of an emergency brake valve placed on the right hand side of the controller drum and shown in our half-tone illustration and in detail in the line engraving. From the upper part of this valve a small pipe leads to a valve known as a pilot valve which is situated inside the controller drum. The emergency brake valve or main valve as it is sometimes called is divided into two parts by a piston, which is connected to a valve opening to the atmosphere, this valve being placed at the bottom of the main valve. The train pipe connects directly to the space below the piston, and the space above the piston is connected to the pilot valve



ELECTRIC CONTROLLER WITH SAFETY BUTTON AND EMERGENCY BRAKE VALVE.

by means of a small pipe. The pressure on both sides of the piston is equalized by a very small hole through the piston. A spring ordinarily holds the piston down, keeping the valve opening to the atmosphere closed. The air pressure in the emergency valve is always the same as that in the train pipe except when the emergency valve is in operation.

The operation of the emergency valve is controlled by the pilot valve, which in turn is operated by the button on the controller handle. This pilot valve closes the end of the small pipe that leads from the upper side of the piston of the emergency valve to the controller drum.

If the motorman should release the button when the train was running and the motors receiving power, not only the train line circuit would be opened but the pilot valve would also be opened by a cam in the controller drum. The raising of the button on the controller handle releases this cam, which presses against the stem of the pilot valve, thus opening it to the atmosphere. This opening allows compressed air to escape quickly from the upper side of the piston of the main valve, and almost instantaneously reduces the pressure to that of the atmosphere. The hole through the piston, although always open, is too small to permit air to pass up fast enough to equalize the pressure on both sides.

The full air pressure on the lower side of the piston lifts the piston against the action of the spring. As the piston rises it carries up with it the valve attached to it. This valve opens the train pipe to the atmosphere, causing a sudden reduction of pressure in the train pipe, which immediately applies the emergency brakes in the usual way and brings the train to a quick stop.

The action of the controller handle button is arranged so that if the reverse lever on the controller is in any other than the mid or neutral position, and the button up, current is cut off from the train line circuits, thus opening all of the contactors, and at the same time the emergency valve applies the brakes. It is clear, therefore, that if the reverser is in either the go-ahead or the back-up positions the motorman must constantly hold down the button, but this does not require very much muscular pressure.

This automatic protective device forms an excellent safeguard against the sudden death or serious illness of the motorman, because if such a thing should happen he would probably loosen his grip on the controller handle, and no matter in what position it might have been, the train would be automatically brought to a stop very quickly.

The automatic train-stopping action of the controller button may also be made use of by the motorman himself while in the full possession of his faculties. In any sudden emergency the motorman has simply to let go of the handle in order to call into play the maximum stopping power in the shortest possible space of time. No conscious adjustment of the controller handle or the brake valve could pos-

sibly be as swift and certain in its action as that which is ensured by the simple slackening of the grasp of the motorman's hand.

In case of local derangement such as, if the controller handle should jam or stick so that it was impossible to turn it to the off position, the motorman has only to release the button and the train would automatically come to a safe stop.

To illustrate what a similar device would be like if applied to a locomotive and just for sake of illustration, suppose that a button or knob held out by a spring had been placed in the end of the throttle lever, and that a spring was placed on the upper disc of the throttle tending to keep it closed. Then suppose that instead of having the throttle bolted directly to the throttle-rod, as is customary, it had a catch operated by the button or knob. With such an arrangement as long as the engineer held the button in, this catch will engage the throttle-rod and the valve would follow the movements of the throttle-lever. But if the engineer released the button, the catch would disconnect the throttle-rod from the throttle and the spring on the upper disc of the throttle valve would close it, thus shutting off the supply of steam to the cylinders. This arrangement would correspond to the opening of the two contacts inside the controller drum which open the contactors, thus cutting off the electric power from the motors. Besides having the button operate the catch, further suppose that it also operates a valve in the train pipe of the brake system. The opening of this valve would apply the brakes. As long as the button was held in by the engineer on this supposed apparatus the valve would remain closed, but on releasing the button it would open this valve and apply the brakes, thus stopping the train. This second attachment would correspond to the pilot valve of the controller drum. A device of this kind is not necessary on a steam locomotive because there are two men together on the engine, but it serves to illustrate how such an attachment would operate.

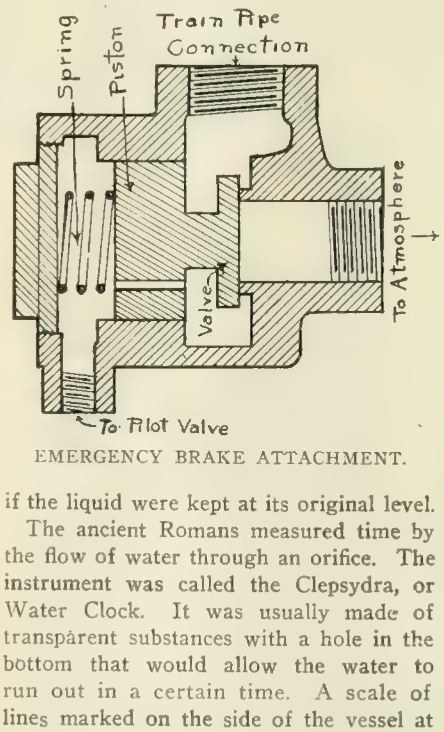
In addition to the "dead man's handle" the circuit breaker on each motor car is held in the closed position by a solenoid called a retaining coil, which is energized through the train line from the control circuit in the cab, where the motorman is. If the train should break in two the train line circuit would be disconnected, and the retaining coils would be de-energized, thus causing the circuit breaker to open. This would cut off the power supply to the motors. Not only would these breakers open, but the train pipe of the air brake system would also be broken and the escape of compressed air would apply the brakes and bring the train quickly and safely to rest.

Elements of Physical Science.

X. HYDRAULICS.

Hydraulics treats of liquids in motion. It shows how water is used as a moving power, and also describes the various machines used for raising liquids. It will be readily observed that the velocity of a stream of water flowing through an orifice depends on the distance of the opening below the surface of the liquid. This velocity is equal to that which is acquired by a body falling the same distance.

For example, in a reservoir full of water three orifices made at the depths of 16, 64, and 144 feet, the liquid would issue from them with velocities of 32, 64, and 96 feet per second, such as would be the velocity of a body falling through the different distances named. These figures apply only so long as the liquid is at the same height in the vessel. If the vessel is not replenished, the pressure diminishes as the liquid gets lower. It takes twice as long to empty an unreplenished vessel through a given orifice, as it would for the same quantity of water to escape



EMERGENCY BRAKE ATTACHMENT.

if the liquid were kept at its original level.

The ancient Romans measured time by the flow of water through an orifice. The instrument was called the Clepsydra, or Water Clock. It was usually made of transparent substances with a hole in the bottom that would allow the water to run out in a certain time. A scale of lines marked on the side of the vessel at different levels, indicated the periods or hours of the day. The divisions were necessarily largest at the top of the scale. Although this instrument served for general purposes it was not correct, as water varies in rapidity according to the temperature and density of the atmosphere.

It may be noted that different liquids escape through openings at different velocities. Mercury flows faster than water, while alcohol has a slower motion than water. The volume flowing through an orifice may also be increased by heating the liquid. Heat lessens the cohesion, and enables liquids to flow more rapidly. It may be added that the friction of water against the sides of pipes has a considerable retarding effect on the velocity of the current, so that an allowance amounting to 50 per cent. is usually added to pipes in excess to what would be sufficient if the element of friction was left out. It will be observed that the velocity of streams is always considerably less near the banks. The windings of streams also retard their velocity. In a straight course a fall of three inches to a mile will give a river a velocity of about three miles an hour. A fall of three feet in a mile will give the impetuosity of a torrent.

The tide, as is well known, is caused by the attraction of the sun and moon acting on the water on the earth, as water being a movable body it yields to the force of attraction. The effect of the sun and moon on the tides is readily seen when these bodies act on the same line which happens at every new and full moon, the tides are highest, and are called Spring tides. When sun and moon act at right angles, the tides are lowest, and are called Neap tides.

WATER WHEELS.

Running water is very useful as a moving power, causing wheels to revolve by its momentum, and so setting machinery of various kinds in motion. There are four kinds of water wheels, the undershot, where the lowest float-board of the wheel is immersed in water, and the current striking against several of the lower boards carries the wheel around. The overshot wheel is furnished with a number of buckets on its rim. A stream is made to fall on the wheel from above. The weight of the water and also the force with which it falls causes the wheel to revolve. As the wheel turns the buckets empty themselves. Much power is saved by this form of water wheel. The breast wheel is also furnished with apartments on the rim, and the water strikes the wheel about the centre. This species of wheel ranks between the overshot and undershot in efficiency. The turbine, instead of being set vertically, is horizontal. To the centre of the wheel an upright pipe is fixed through which the water descends. To the inner rim of the wheel is fitted a fixed cylinder divided into apartments, the wheel itself being divided into similar apartments but running in the opposite direction. The fixed cylinder is connected with the base of the upright tube. The water from the pipe filling the apartments in the fixed cylinder is discharged into the corresponding apartments of the wheel which moves and allows the water to escape after having spent its force in moving the wheel. Where a great height can be secured a small body of water will produce an enormous force by using this form of wheel.

In recent years the use of this form of wheel in driving dynamos has been very successfully introduced in the vicinity of Niagara Falls.

Eminent Engineers.

IV. THOMAS SAVERY.

Thirty years after the death of the Marquis of Worcester, a marked improvement comes into the history of the steam engine. Captain Savery was evidently a seafaring man, but of his history we know little. He was the author of a pamphlet describing a scheme for rowing ships in a calm. He secured a patent but it seemed at that time it was necessary to have the endorsement of the government before any radical experiment looking towards marked improvements could be made. The English government officials in the seventeenth century must have been wofully dull in engineering. Savery submitted to the Navy Department a working model of his engine in a wherry, a kind of boat where 16 men could act as rowers, sometimes assisted by a sail if the wind was favorable. Savery's engine consisted of a steam boiler, the steam acting upon a number of reciprocating pistons. The piston rods were furnished with teeth which acting on a series of racks turned wheels in the water on the same principle as the paddle wheels of later inventions. It worked admirably, but the naval committee disapproved of it.

Sir Isaac Newton was then president of the Royal Society, and brought Savery to the personal attention of King William, who encouraged Savery in his inventions. The inventor shortly afterwards exhibited his most important improvement in steam engineering before the Royal Society. This was in 1699. He named his invention "The Miner's Friend." Its sole purpose was for raising water, and consisted of a series of receivers which when filled with water, steam from a boiler was allowed to flow in and the water was thus forced through connecting pipes to higher levels. A system of valves readily controlled the flow of steam or water. When the receiver was emptied of water and full of steam a cooling process created a vacuum and by a system of piping, the water from another receiver was raised still higher, and this alternate emptying and refilling of the receivers was prolonged at pleasure. It was the most successful scheme of water raising from mines or into public and private buildings hitherto attempted. He also carried his scheme further by first raising a body of water and then allowing the water to fall on a water-wheel and so produce rotary motion.

In his published pamphlets he gives minute directions for the erection of his engine, but of the dimensions he says little. The furnace was so contrived that the flame took a turn or two round each of the boilers. The greatest boiler made under his superintendence was 30 inches in diameter. The fire-place was 15 inches by 20 inches, but from this limited generating space he raised water in a three inch pipe to a height of 60 feet. The most ingenious part of his contrivance was the continuance of the current of water raised during the period of replenishing his boiler. This was accomplished by the use of a second boiler of smaller dimensions, the pressure of which by a series of pipes and valves kept up the pressure during the intermittent changes on the action of the larger boiler.

This cumbrous contrivance continued in operation for many years, and while there has been some variety of opinion in regard to Savery's claim to originality, there is but one opinion in regard to the usefulness, the power, and in many respects the beauty of the invention, and if his contrivances are merely considered as a clever adaptation of other existing ideas, the results were such as to mark a mind of the very highest order in mechanical engineering. It is gratifying to know that King William did not lose sight of the inventor.

Questions Answered

CHECK VALVE ON TOP OF BOILER.

(7) J. W. M., Carbondale, Pa., writes: In your January issue there is on the facsimile of your educational chart No. 9, of the consolidation engine, a boiler check on top of the boiler back of the smokestack. Will you please say what are the advantages of this form of check? A.—This is the Phillip's double boiler check valve made by the Nathan Manufacturing Company, of New York. Some of the advantages claimed for this form of check are, it is in a comparatively protected position and in case of collision or other accident might not be as readily knocked off as check valves placed on the side of the boiler. There is a safety check valve inside which is intended to close automatically in case of any part of the body of the device is broken. The valves being on top of the boiler and not coming in constant contact with water are said to wear longer than where water from within the boiler can get at them. Either or both passages from the delivery pipes can be shut off when desired and one or both check valves can be ground in or repaired without blowing off steam. See detailed description in another column.

E. T. BRAKE EQUIPMENT.

(8) J. W. M., Indianapolis, Ind., writes: I had the following experience with the E. T. equipment: When the brake valve was moved to service position and a reduction made, and the handle then returned to lap position, the engine brakes would release, no matter how large or how small the reduction was. The distributing valve was very dirty. It was cleaned and put back, but same thing happened. I took the H.5 brake valve apart and cleaned and oiled it; the equalizing piston was very much gummed up. After this was cleaned and put together again it worked all right. What I want to know is, What was the defect?—A. With the E. T. equipment there must be leakage from the application chamber to exhaust off the brakes. It is likely that when you put the brake valve together you applied a new rubber gasket between the pipe bracket and valve, thereby overcoming a leakage to the atmosphere through this gasket. After some service this gasket becomes more or less oil soaked, which renders it porous and leaky.

BRAKES SET TOO SOON.

(9) L. B., Salem, Ill., writes: We have had some trouble with an engine, and the trouble is with the brakes. The triple is all O. K. and the brake valve is all right, and the packing leather in the cylinders gets air properly when the engine stands alone, but when the engine is on the train the engine brakes will set. We have tried everything but have not found the trouble yet. There is no water in the main reservoir and we have tried all leaks in train line.—A. If the triple valve is in good condition and the engine is coupled to the train with a reduced auxiliary reservoir pressure, as it should be, that is by making two or three service applications without recharging, the triple valve will be forced to release position as soon as the brake pipe pressure is increased beyond that in the auxiliary. The brake might reapply due to an enlarged feed groove, or a wrong triple valve used on an auxiliary reservoir, or from a brake pipe leak if the supply through the feed valve is irregular. If the reservoir and brake pipe are both charged without forcing the triple valve to release position, the brake pipe pressure must have passed the packing ring on the triple piston. On the light engine and short brake pipe the rise in brake pipe pressure at the time of release is quite rapid, and a triple valve with a poorly fitted ring will be forced to release while the increase in brake pipe pressure, when coupled to the train, is comparatively slow, which will allow some time for air to leak past the ring and charge the reservoir. Where there are no facilities for testing the triple valve, the ring can be tested by placing some obstruction about ¼ of an inch wide above the triple piston which will prevent the feed groove from opening, then by replacing the cap and opening the stop cock slowly, to avoid bending the piston, packing ring, leakage will be free to escape at the reservoir bleeder cock. If an air gauge, a ¼-in. nipple and socket, can be secured, the leakage in pounds per minute can be determined. After removing the obstruction the feed groove can

be tested; with the proper sized triple valve and reservoir, the gauge should show 70 lbs. in from 60 to 85 seconds after the stop cock is opened.

BOILER WASHING.

(10) B. I. G., Huron, So. Dak., writes: I would like to learn the best and quickest method of cooling and washing boilers in a bad water district. In one engine house I visited recently they open the blow-off cock just as soon as the engine gets into the house and blow the water all out, then take out the plugs and go ahead washing. On one road they first blow the steam off through the syphon cock, then fill the boiler through the syphon cock up to the whistle, then take out a plug in the water leg and keep the water going through the boiler until the boiler is cooled off, then take out the plugs and the boiler is ready for washing. The object is to cool the boiler uniformly.—A. Cooling the boiler gradually and uniformly is important. Some roads use hot water to wash out with, but where this is not done a good way is to fill up the boiler as high as convenient with both injectors, after the fire is out, this helps to reduce the steam pressure; then blow off the steam. Take down a tender hose and attach the shop hose by a convenient coupling to the suction pipe of the injector and keep water flowing into the boiler through the injector and its pipes. Open the blow-off cock so as to let about as much water out as goes in. Cold water is thus introduced into a full boiler of hot water at a point not close to the fire box, and this process can be kept up until the boiler is sufficiently cool. Then shut off the water, open wide the blow-off cock and take out a plug or two to hasten the outflow, and proceed with the washing. In this connection it may be mentioned that when putting the wash out plugs back in place before filling up, smear them with a little of Dixon's Graphite grease; this will make them come out easily and quickly next time the boiler has to be washed out.

AIR PUMP TEST.

(11) H. M., Fort Scott, Kan., asks: Is there any appliance made or can one be made in order to test air pumps to see if they are still furnishing enough air for their size? It seems to me there should be something of this kind in use so when an air pump got below a certain standard it could be removed before it caused an engine failure and still use it as long as there was good service in it. We have a great many pumps reported when in reality it is the fault of the train pipes.—A. Yes. A very good shop test to determine the capacity of an air pump was described in the September issue of Railway and Locomotive Engineering, page 417. It consisted principally of a number of reservoirs, to which the air brake hose at the rear of the tender could be coupled. The condition of the air cylinder of a pump can be ascertained by pumping up the pressure and removing the air cylinder head. Then run the pump slowly. Any leak past the packing rings can be detected and the condition of the air passages and back leakage from the main reservoir can be noted. The lift of the air valves is of more consequence than is generally supposed, especially when working against a high air pressure. The pump should be removed from the engine for inspection at certain periods. The time the pump is allowed to remain on a locomotive should depend upon the class of service it is used in. If for any reason the pump cannot be removed it should be subjected to a rigid inspection, which should include all of the movable parts.

Loss of Our Friend the Atom.

Nearly all intelligent enginemen and many others who have studied the principles of combustion are familiar with the Atomic Theory of matter. This theory teaches that all bodies or substances are made up of molecules, and molecules are made up of atoms. All chemical changes are changes in the arrangement of the atoms, and the combined weights of the elements are the relative weights of their atoms.

Chemistry has shown that there are about seventy elementary substances constituting the earth, water and air, and that elements cannot be subdivided sufficiently to produce any other element. Thus, no matter how finely oxygen, the life-giving element of nature, may be broken up by chemical or electrical processes, nothing but oxygen atoms will be found. The same with the elements hydrogen, iron, gold, silver, mercury, etc.

Dr. Dalton, of Manchester, England, discovered what is known as the law of multiple proportions, that is the proportions in which elements unite to form different compounds. Dalton assumed: 1. That all matter consists of ultimate and unchangeable particles or atoms. 2. That atoms of the same element have a uniform weight, but that in different elements they have different weights. 3. That the combining numbers of chemistry represent these relative weights. 4. That between these different atoms there are attractions which unite them into chemical compounds.

The science of chemistry has been developed to a great extent upon this theory that the atom represented the ultimate condition of any element. Some theorists held that all matter must have developed from a single element, probably hydrogen, but nothing was produced to sustain or support that theory.

The ordinary investigator into the constitution of matter was contented to repose with confidence upon the atomic theory until the discovery of radium and its marvels which upset many of the theories and threw doubt upon chemical discoveries. Experiments with radium seem to show that the atom is composed of smaller particles called electrons or corpuscles.

A most amazing statement follows to the effect that the corpuscle is nothing but a disembodied electrical discharge. That a corpuscle contains nothing material, being electricity, which is merely a form of force. According to the latest discoveries—not theories, the corpuscle is a disembodied electrical charge, containing no matter, and is the term which will be employed to designate this ultimate of which all so-called matter is probably composed.

We are sorry for our old friend the atom, which has been robbed of its identity by that unscrupulous brigand radium. Until more discoveries are made and the new discoveries are rendered more intelligible, we will continue to make our chemical formulas according to the discredited atomic theory of matter, for it is convenient, a thing that cannot be said about electrons corpuscles.

Why Piston Rods Break.

In nine cases out of ten where piston rods are broken the fracture occurs through the keyway and is caused by injudicious driving of the tapered key. An examination at the fracture will generally show that the bit was only at the end of the taper and at the shoulder, caused by driving the key hard enough to stretch the material of the rod at its weakest point, which is the location of the keyway. The crosshead key has so slight a taper that the rod can be broken by driving it too hard. A little intelligent care in driving piston rod keys would prevent many of the breakages that entail serious damage to other parts.

G. T. R. Improves Stratford Shops.

The Grand Trunk Railway Company are making extensive additions to their Stratford shops. A machine and erecting shop 616 ft. long by 175 ft. wide is being put up, and a boiler shop 154 ft. long by 135 ft. wide is being added. The buildings are being built on concrete foundations and the walls are of reinforced concrete.

Call on a business man at business times only, and on business; transact your business and go about your business.—*Duke of Wellington.*

Air Brake Department

Cleaning Locomotive Triple Valves.

This subject and some of the following expressions may appear rather old, but there are young and inexperienced air brake repair men coming on continually, and probably always will be. The present standard types of triple valves will soon be a thing of the past and everybody interested in their proper maintenance should be perfectly familiar with their construction and operation before attempting to keep in repair the later types of triple and distributing valves. The Air Brake Men's Association has for a number of years strongly advocated the removal of triple valve from cars and locomotives for cleaning, repairing, and testing.

The Westinghouse Company also recognizing the desirability of removing the valves, has so designed their later types of triple valves, excepting those of the type K, quick service, that they can be removed, and replaced with others, without breaking any pipe connections, which is done by making all of the pipe connections to the brake cylinder head or triple valve bracket as the case may be.

The air pressure for operating the triple valve is delivered through parts in the cylinder head which correspond with those in the triple valve, the valves are known as the "pipeless" type and the only joint broken when removing them is the body gasket.

No matter how necessary, or desirable it is to remove a triple valve for cleaning or testing, there are certain times in almost every engine house, when this cannot be done, owing to the short space of time the engine is to remain in the house, and to the lack of material to make the change, and whenever it is necessary to clean the triple valve without removing it, a competent man should do the work.

Assuming that a quick action triple valve under the tender is to be cleaned the triple valve should be cut out, the reservoir bled, and the graduating stem nut loosened before removing the cylinder cap; it may save a trip to the vise bench or the necessity of replacing the cap for the purpose of loosening the nut. If a small quantity of coal oil is put on the part of the bolts extending through the nut, the nut will come off much easier and probably save a few minutes time in removing the cap.

After the piston and slide valve are withdrawn and placed in a can of kerosene, and a piece of oily cloth is rubbed around in the bushings, the union nut should be disconnected and the check valve case removed.

Particular attention should be given to the emergency parts. The check valve should, of course, have a bearing on its seat, the check valve spring should be of eleven coils, and 1¾ ins. long. When any permanent set shortens this to 1⅝ ins. it is out of standard and should be renewed; the reason for this needs no explanation.

The fit of the emergency piston in the guide is very important, and the result of the piston sticking in the guide is well known, it should revolve freely in the guide. After finding out and knowing that these parts and the gaskets are in good condition the strainer can be cleaned and the lower parts put together.

The triple piston and slide valve, and the bushings in the triple should then be wiped off, and the feed grooves cleaned with a piece of hard wood. It should be known, not guessed at, that the packing ring has a good bearing and comes together neatly at the ends when inserted in the cylinder. This can be determined by entering the piston, holding the slide valve end in the hand. Then rubbing the piston back and forth a few times in the dry cylinder the bearing of the ring will show. By pushing the piston in as far as it will go, and revolving it in the bushing a bent piston will show, when the piston and slide valve are then entered in the regular way, the difference between packing ring and slide valve friction will be noticed. The slide valve spring must not be too strong, and when the ends are worn sharp enough to cut, or catch on the bushing, the spring should be renewed.

The slide valve should have a bearing all over its face and be square and sharp, at the edges of the wearing sur-

THE DEERFIELD RIVER, NEAR CHARLEMONT, MASS., ON THE BOSTON & MAINE.

The emergency valve used in the F-36 or F-27 triple valves is 3⅜ ins. long and the stem ⅜ of an inch in diameter, that of the F-29 valve is 3¼ ins. long and the steam 7/16 of an inch in diameter; therefore, it will be seen that the emergency valve of the F-29 triple is shorter and heavier, and these should be used in the triple valves for which they are intended.

The short end of the valve can be inserted in the emergency piston and revolved with the thumb and finger which will show if the valve is bent. It should have a good rubber seated gasket, and the opposite side of the projection upon which it rests should be examined, as there is frequently a crack all the way around the stem which may result in breakage and subsequently in a detention.

face; if it is not, some particles of dirt will work under the slide valve, which would otherwise be pushed away by the movement of the valve. The dirt working under the valve will cause the triple to require frequent cleaning. The graduating valve can be tested in the same manner that a gauge cock is usually tested for leakage by a machinist.

The depth of the exhaust cavity in the face of the slide valve of an F-29 triple valve should not be less than 1/8 of an inch, not less than 3/32 in the F-27, nor less than 5/64 in the F-36.

The graduating springs must be examined, and that of the F-29 and F-27 triple valves should be 2⅝ ins. long and of 13¼ coils, that of the F-36, 2¾ ins. long and of 16 coils; the springs should have no permanent set or be distorted in any way and should be stretched several times, lightly, to see that they will again come back to the proper length.

If the inspector finds all the parts in good condition the valve and bushings should be lubricated and the triple valve be put together. The cylinder cap gasket should be soft, and in good condition, the graduating stem nut will be the last to tighten.

From the foregoing it will appear as if this would take up considerable time, but it can be done very quickly, and after the triple valve is cut in and all the joints tight the brake should be used in the emergency position several times as well as the service. All joints should be tested with a torch, and the finger should be held over the exhaust port for a few seconds.

A pretty fair test for a leaky triple piston packing ring can be made by applying the brake with a service reduction, closing the stop cock in the crossover pipe, and reducing the auxiliary reservoir pressure by means of the bleeder cock. The small volume of pressure between the stop cock and the triple piston should force the triple to release position if the ring is in good condition, and no leakage exists. If it is not forced to release, the pressure bottled up has either passed the ring, leaked to the atmosphere through a defective gasket, or got into the brake cylinder past the emergency valve.

If there is a little time left the feed groove can be tested by attaching an air gauge to the auxiliary reservoir. This test sometimes proves to be good practice, as wrongly used triple valves have been discovered in this manner which otherwise might have passed unnoticed.

Inspection of Locomotive Brakes.

The inspection of all air brake apparatus on locomotives after each trip is a matter that cannot be given too much attention. That a thorough inspection be made it is necessary that the inspector's knowledge of air brake troubles, their causes and effects, be of such a character as will enable him to readily detect any weakness before it gives trouble. Trouble is easily detected after it has entirely developed. In addition to thorough inspection a good practice for better maintenance is that of a systematic and periodical test and cleaning of pumps, triple valves, brake valves, air gauges, etc.

For instance, at such periods as conditions of service may warrant give the pump an efficiency test, which may be done by designating a certain length of time for the pump to raise the pressure to any number of pounds according to the volume into which the air is compressed or by establishing a constant leakage for the pump to maintain against a certain pressure at a reasonable number of strokes per minute. A very reliable test is, allow a leakage through a hole 3/32 in. in diameter at a pressure of 70 lbs., the pump working 40 strokes per minute. Then remove the air valves and thoroughly clean all scale and gum from them with gasoline or kerosene. The result will be that not only will you have an efficient pump, but a systematic record showing its reliability.

The frequent cleaning and oiling of triple valves will ensure properly acting triples and eliminate a great amount of undesired quick action. An air gauge indicating incorrect pressures may cause serious delay on account of sticky brakes because of no excess pressure, although it may be shown by the gauge. The discovery by inspection of a missing cotter key that would require five minutes to replace is a desirable thing. This key if not replaced usually results in a pin or bolt working out of place, letting down a brake beam to be torn off, which not only delays a train but requires a new brake beam and considerably more than five minutes to apply, resulting in an increased cost of brake maintenance.

There are so many delays, accidents, and so much cost saved by thorough and systematic inspection that it does not seem possible to ignore its importance.

Waste in the Independent Brake Valve.

On a new engine equipped with the E. T. brake, trouble was experienced with the brake staying on except when the handle of the independent brake valve was in full release position.

After taking the brake valve apart a piece of waste was found to be holding the rotary valve of the independent brake valve away from its seat in such a manner as to allow air to leak into the application cylinder pipe; also the waste was blocking the port leading to the automatic brake valve, which accounts for not being able to get the brake off with the automatic brake valve.

The remarkable part of the matter is where did the waste come from.

Cutting Tools.

Among the many changes that have occurred in the application of machinery to machine construction and repair, there are none that have contributed more to make possible the perfection of detail in the mechanism of today than the improvement in the quality of material of which the cutting tools are composed. To those whose memories can run back to what may be called the early days of the locomotive, it would seem as if new metals had been discovered, and in some respects this is the case, for the steel of fifty years ago was as pig iron compared to the steel of to-day.

In nothing is this more apparent than in the amount and quality of work that is now being done on turning lathes. We have had occasion from time to time to describe the rapid progress made in this important department of machinery, and we confess that our descriptions have hardly kept pace with the vast strides of recent years. Turning the tires of locomotive wheels is, perhaps one of the hardest tests to which any machine could be put. The metal is of the hardest and toughest When worn the steel has by the severest kind of usage changed its consistency to a degree of brittleness and hardness that seems impenetrable. These qualities are augmented by patches of a calcined quality that seems as strangely mixed as a chilled meteorolite that has apparently fallen from some far-off planet, yet our steel manufacturers have found means to produce metals from which cutting tools can be forged that will strip the worn rims half an inch deep at the rate of twenty feet per minute, and leaves a surface which can be smoothed in one cut of the finishing tool.

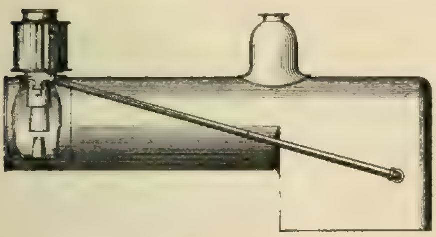
The massiveness and solidity of the machines have contributed to this important result, and added to this is the fact that nearly all of the new railroad shops are furnished with their machinery set on heavy foundations on the solid earth. The destructive element of vibration is thereby eliminated, and the old rattletrap machines rumbling like a thunderstorm in the Catskill Mountains are happily lapsing into silence. The gatherings at the grindstone are mere memories, and the element of durability seems to have entered into the composition of the modern cutting tools.

Recreation is intended for the mind as whetting is to the scythe. He, therefore, that spends his whole time in recreation is ever whetting, never mowing, and he that always toils and never recreates is always mowing, never whetting.—*Bishop Hall.*

Patent Office Department

SPARK AND CINDER DEVICE.

Mr. S. Benson, Chicago, Ill., has patented a spark and cinder eliminating device, No. 846,448. The device may be applied to all steam generators in which exhaust steam is used to force the draught. The object is to automatically separate the gases from the solid products of combustion, and to return the latter to the furnace to utilize their fuel energy. This is attained by the application of centrifugal force induced by the impact of the exhaust steam upon the smoke within a fixed duplex turbine wheel, suitably constructed and arranged within the body of the stack, which imparts a rapid horizontal whirling movement to the gases escaping through curved ports around the periphery of the wheel, which is enclosed in a casing. The smoke when thus centrifugally filtered is pushed back inwardly and escapes at the usual vent. The heavier matter is driven into the slots provided in the outer casing. It is then whirled downward through the separating chamber and tubular connections back to the fire-box.

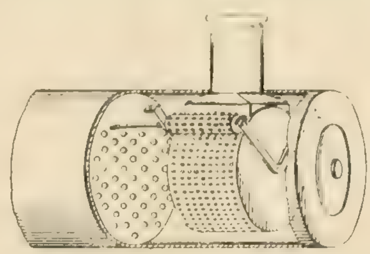


SPARK AND CINDER DEVICE.

As is shown in the accompanying illustration the outer stack or drum is about the size of the sand-box or dome. No netting or baffle plates are said to be necessary. The draft is regulated by the petticoat pipes, which are set low to obtain a long drive column above the exhaust nozzle. The automatic action of the turbine induces a rapid motion of the cinders, and as all movement is in the direction of least resistance, the sparks and cinders readily and rapidly find their way back into the fire-box.

SPARK-ARRESTER.

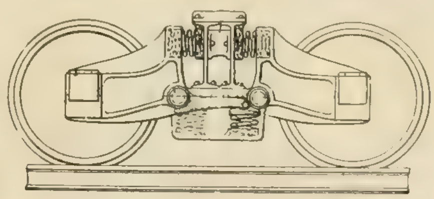
Mr. J. H. Hines, Philadelphia, Pa., has patented an improved spark arresting device, No. 874,768. It embraces a locomotive furnished with a smoke box, and a smoke stack extending down into the smoke box with its lower end extended. There are brackets in the smoke box with a rotary screen journaled in the brackets with its periphery adjacent to the extended portion of the smoke stack. There is also a rotary cleaner journaled in position for engaging with the screen and simultaneously rotating and cleaning the screen, the cleaner having projections for that purpose. A pulley and other means rotate the cleaner and screen.



REVOLVING SPARK ARRESTER.

CAR TRUCK.

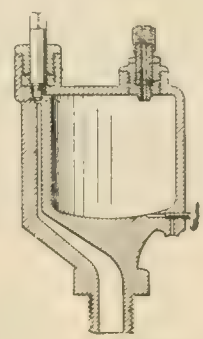
A car truck has been patented by Mr. W. E. Amberg, Chicago, Ill., No. 870,607. It comprises wheels and axles in combination with a transom having hinge members upon its ends, spring brackets depending from the ends of the transom, side frame members extending from the axles and at their inner ends hinged upon the transom, the side frame members having arms extending beneath the ends of the transom and springs interposed between the arms and brackets.



NEW FORM OF CAR TRUCK.

LUBRICATOR.

Messrs. W. and J. W. Leyland, New York, N. Y., have patented a lubricator, No. 873,319. It embraces a combination of a lubricant receptacle having a common conduit for the inlet of steam and the gravitating outlet of oil and a tell-tale sight consisting of a screw plug fitted to the top of the receptacle and having a communicating passage. There is also a glass tube fitting in a bore in the plug and communicating with the passage therein, the plug being formed with sight openings exposing the glass tube in part, and also means for sealing the upper end of the glass tube.



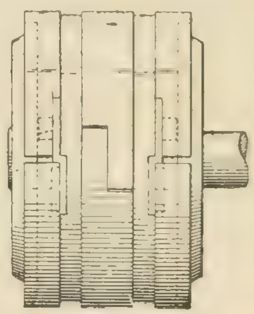
LOCOMOTIVE LUBRICATOR.

BOILER.

Mr. W. J. Ogan, Dayton, Ohio, has patented a boiler, No. 874,423. It comprises a shell, a fire tube formed of upper and lower curved plates within the shell, one end of the fire tube terminating in a bell-shape, means for supporting the bell end within the shell, a fire box to which the other end of the fire tube is connected, and a series of water tubes extending across the fire tube throughout its length.

PISTON AND PACKING.

Mr. M. H. Sullivan, Poughkeepsie, N. Y., has patented a piston and piston packing, No. 873,806. The piston has an annular circumferential channel, with a bull ring in the channel, and also a similar channel in its outer side. There are screws carried by the piston to adjust the bull ring, and a carrier ring in the channel of the bull ring. There is a stop element extending across the open side of the ring which is secured to one end portion of the ring and slidably secured to the other end portion of the ring to permit contraction and expansion of the ring.



PISTON AND PISTON PACKING.

Net on Locomotive to Catch Quail.

Engineers who run through the western part of Oklahoma tell some great stories about the way in which quail are killed by coming in contact with their engines, and claim to have a bunch of them on the pilot at the end of every run.

One Choctaw fireman has evolved a scheme to fix up a net on the front of his locomotive and catch the birds as they come against it.

Engines for the Nickel Plate.

The New York, Chicago & St. Louis Railroad, usually advertised as the Nickel Plate line, has received a short time ago a number of locomotives from the Baldwin Locomotive Works. Six of them are ten wheel engines for passenger service and three are consolidation engines for freight service. Both types are shown in half-tone illustrations. Both are equipped with ordinary balanced slide valves and both have Walschaerts valve gear.

The passenger engine has single expansion cylinders 20 x 26 ins., driving wheels 72 ins. in diameter, and develop a tractive effort of 24,670 lbs. In order to have the motion as nearly as possible in one plane and thus avoid the use of rocker shafts, the steam chest center lines are placed 3 ins. outside of the cylinder center lines. The maximum width over the cylinder castings is 9 ft. 10 ins. The combining lever is placed back of the crosshead, the valve rod guides are supported by a guide bearer, and the valve rods are rectangular in cross section at the points of support. A suitable crosstie, placed between the first and second pairs of driving wheels, supports the link brackets and reverse shaft bearings, and is braced to the guide bearer sheet by two pieces of angle iron. The return cranks are of cast steel, secured to the main crank pins by through bolts. The radius rod hangers are placed in front of the links, and only one reverse shaft is employed.

The main frames are of cast steel, with single wrought-iron front rails. The pedestal binders in this design are cast-steel yokes and cast-iron filling pieces. This Baldwin pedestal binder is a steel casting, the sides of the yoke being 2½ ins. wide by 1 7/16 ins. thick. The bearings against the pedestal jaws are curved to a radius of [illegible] in. The clamping is effected by a large set screw with 2¼ in. thread. Should the yokes become loose they are prevented from falling by safety clips, bolted up. This new design of pedestal binder is shown in detail in our line engraving.

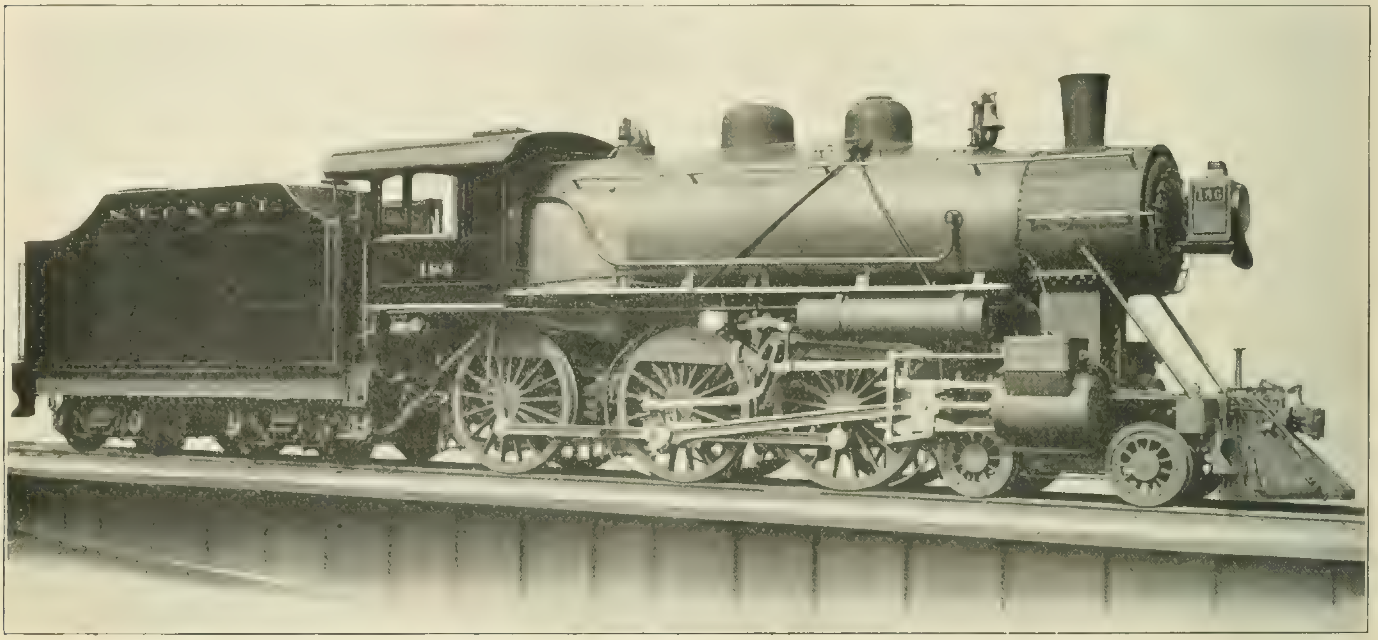
The equalization of weight is arranged with inverted leaf springs between the second and third pair of driving wheels, while the frames are supported at the rear by means of coil springs. These features are common to both the passenger and the freight engine.

The boiler of the 4-6-0 engine is of the extended wagon top type, with two rings in the barrel, the first being tapered. It has a diameter at the front of 62 ins. The dome is placed on the second ring, which has a welded seam on the top, with an inside liner ½ in. thick and 88½ ins. long. The center line of the boiler is placed 9 ft. 9 ins. above the rail. The grate is sloped toward the front, and the depth from the center line of the bottom row of tubes to the under side of the mud ring is 24½ ins. The firebox is supported by sliding shoes in front and a buckle plate at the rear. The heating surface is 2,600 sq. ft., made up of 133 in the firebox and 2,467 in the tubes. There are 296 tubes each 16 ft. long. The grate area is 41.8 sq. ft., which gives a heat absorbing surface about 62 times as large as the grate.

The cab is roomy and comfortable, with one large window in each side. Owing to the height at which the boiler is carried, the firing deck is about on a level with the running boards. The headlight bracket is bolted to the smokebox door.

The tender is built to designs furnished by the railroad company. It has a steel channel frame, carried on archbar trucks, which are equipped with triple elliptic springs and steel bolsters. The tank has a deep water bottom, with sloping floor in the fuel space. The tank capacity is 6,500 gallons and the fuel carried is 14 tons of soft coal. Some of the principal dimensions are as follows:

Firebox—Length, 95⅛ ins.; width, 62¼ ins.; depth, front, 65¼ ins.; depth, back, 50⅞ ins.
Water Space—Front, 4 ins.; sides, 4 ins.; back, 3½ ins.
Tubes—Material, iron; wire gauge, No. 12; diameter, 2 ins.
Engine Truck Wheels—Diameter, 33 ins.; journals, 5½ by 12 ins.
Boiler—Working pressure, 200 lbs.
Driving journals, 9 ins. by 12 ins.
Wheel Base—Driving, 15 ft. 3 ins.; total engine, 26 ft. 3 ins.; total engine and tender, 52 ft. 4½ ins.
Weight—On driving wheels, 113,700 lbs.; on truck, 42,650 lbs.; total engine, 156,350 lbs.; total engine and tender, about 285,000 lbs.
Tender—Wheels, diameter, 33 ins.; journals, 5½ by 10 ins.



NEW YORK, CHICAGO & ST. LOUIS TEN-WHEEL OR 4-6-0 TYPE LOCOMOTIVE.

E. A. Miller, Supt. Motive Power. Baldwin Locomotive Works, Builders.

The consolidation or 2-8-0 type are of moderate weight, with comparatively large driving wheels, thus making them suitable for fast freight service. They can exert a tractive power of 27,700 lbs. The cylinders are 19 x 28 ins., driving wheels 62 ins. and 200 lbs. of steam is the working pressure. The adhesive weight is 148,950 lbs., that on the engine truck is 18,650 lbs., thus giving a total of 167,600 lbs., and with the tender the total weight comes up to about 375,000 lbs.

In many respects these engines are similar to the 10-wheel engines described above. The cylinders are so arranged that the valve gear is in a ver-

tical plane. In this engine the link bearings are bolted to the guide yoke, and the valve rods are driven from crossheads which slide on suitable guides. The arm of the reversing shaft, which is connected to the reach rod, points downward, but the gear is so arranged that the block is in the lower half of the link when the engine is running forward.

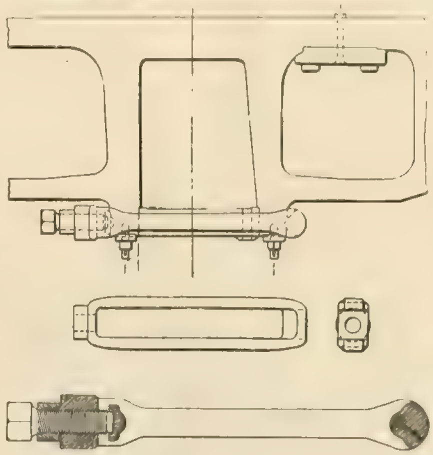
The leading driving wheels are equalized with the engine truck, while the remaining driving wheels are equalized together by beams placed over the driving boxes and intermediate leaf springs are used. The pedestal binders are similar to those used on the 10-wheel engines and which are shown in our line cut. The frame crossties include a substantial steel casting, placed above the main driving pedestals. This casting also serves as a support for the front of the firebox, which is carried on buckle plates at each end.

The boiler is of the extended wagon-top type and measures 64⅛ ins. in diameter at the smokebox end. There are 306 tubes, which being each 14 ft. 10⅛ ins. long, give a heating surface of 2,361 sq. ft. This added to 153 sq. ft. contributed by the firebox gives a total of 2,514 sq. ft. This is a little over 61 times the grate area, which is 41 sq. ft.

The tenders are similar to those used on the passenger engines, but they have smaller tanks. The fuel capacity amounts to 14 tons, and 5,500 gallons of water is carried.

The following are the principal dimensions of the consolidation engine:

Driving Journals—Main, 9 by 11 ins.; other driving journals, 8½ by 11 ins.
Wheel Base—Driving, 6 ft. 0 ins.; total engine, 25 ft.; total engine and tender, 62 ft. 5½ ins.
Firebox—Length, 95 ins.; width, 62¼ ins.; depth, front, 68 ins.; depth, back, [illegible] ins.
Water Space—Front, 4 ins.; sides, 3½ ins.; back, 3½ ins.
Tubes—Material, iron; wire gauge, No. 11; diameter, 2 ins.



DETAILS OF PEDESTAL BINDER,
N. Y. C. & ST. L.

Engine Truck Wheels—Diameter, front, 32 ins.; journals, 6 by 12 ins.
Tender—Wheels, diameter, 33 ins.; journals, [illegible] by 9 ins.

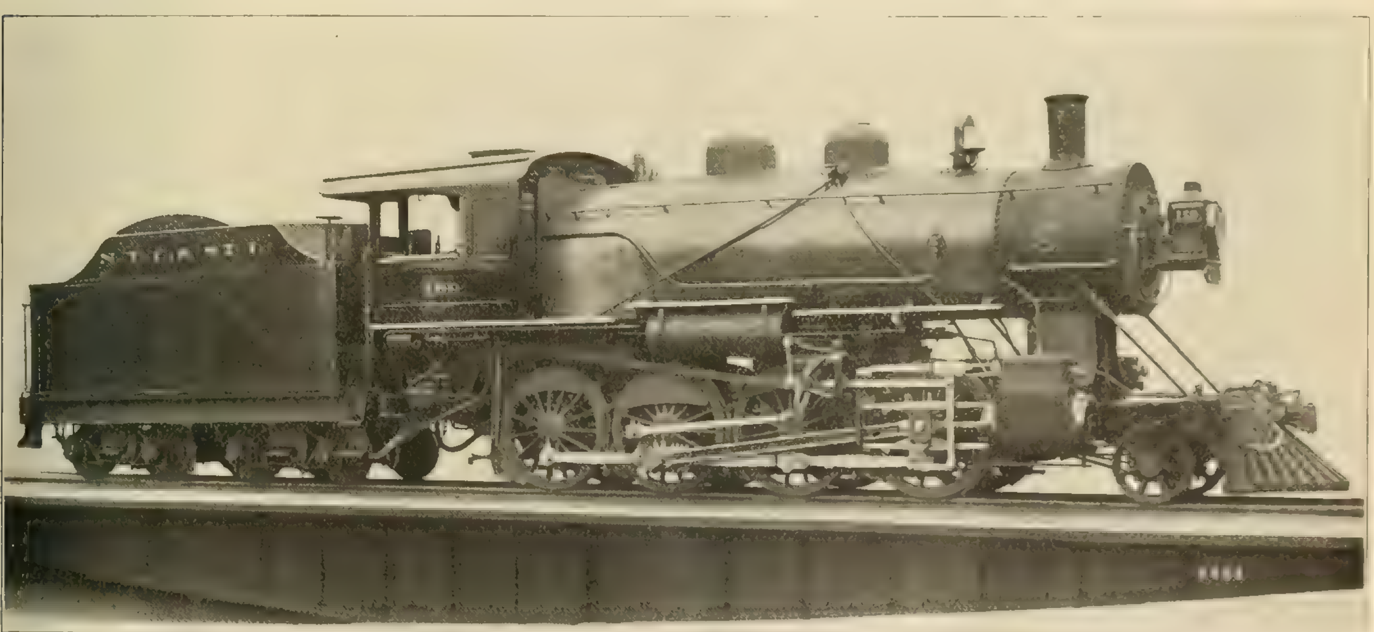
Economical Locomotive Handling.

Quite a representative body of local officials, engineers and firemen recently attended a meeting at the Railroad Y. M. C. A. at Boone, Ia., to hear Mr. W. H. Bradley, assistant master mechanic of the Chicago & North-Western, address them on, How to take advantage of, and handle a locomotive economically. His address was followed by an animated discussion by the men, concerning the different phases of the subject and the causes that lead up to and bring about engine failures, and how they can best be avoided. The discussion was eminently practical and with a view of permitting others to take part in the discussion, we print Mr. Bradley's address. Our columns are always open to practical men for the expression of opinions and to give their experience.

Mr. Bradley said: As this subject should deal with both engineer and fireman, the author deems it necessary to make an imaginary trip on a modern engine, as a fireman and as an engineer.

The fireman should first consult train and bulletin board so that he would know what engine and train he was going on, and the special instructions that might affect his train; he should be as familiar with all instructions as his engineer. He should then repair to his engine in plenty of time to do his work properly and intelligently, he should first know that he has plenty of water in the boiler, that flues and fire box are tight, and that his fire is burning properly; he should know that the grates are straight and connected, and ashpan clean; he should inspect lamps and firing tools, and know that he has everything needed for the trip; after he has performed these duties he should willingly assist his engineer in getting the engine ready.

This latter duty if faithfully performed will be the means of teaching the fireman many points that will be valuable to him when the time comes for him to take charge of a locomotive. When the engine is ready to get out of the house the fireman should be on the left seat box facing in the direction which the engine is to be moved; this will enable him to keep watch for anything which does not clear, or for anyone that is liable to personal injury. After he has taken a full tank of water, and knows that he has plenty of fuel, he should commence building his fire up gradually with two scoops



CONSOLIDATION LOCOMOTIVE FOR THE NICKEL PLATE.
E. A. Miller, Superintendent Motive Power. Baldwin Locomotive Works, Builders.

of coal at a time so that when it is time for train to start he will have the maximum steam pressure, and his fire will be the required thickness for the work to be performed. As train is started he should know that the bell is rung, and while the train is being forced to the required speed, and reverse lever is hooked toward center, he should feed the fire often enough to keep the fire the required thickness without putting on more than 3 or 4 scoops of coal at one time, swinging the door between shovels; when lever is hooked up to the running notch the fireman can now fire with more uniformity and precision. Spacing the fires more closely together, approaching a grade where lever will be worked well forward in quadrant, bearing in mind that he should not increase the amount of coal at each fire, but increase the number of fires.

After the summit of the grade is reached, and the lever is hooked back to the running notch, he should lengthen the space between fires; he should also have a supply of fuel on his fire in time so that he can be on his seat box going around curves or passing through stations where they do not expect to stop; approaching a station where a stop has to be made he should have his last charge of coal on the fire far enough back, so that the gases will be burned off, and the temperature will be lowered enough to avoid the escape of steam at the safety valve.

So far as firing is concerned this practically is the regular routine, and should be kept up until the completion of the trip; when signals and tools should be put away, and fire left in condition to last until engine despatcher can take charge of engine. He should now repair to the round house and register correctly; after which he is at liberty to enjoy a well earned rest, but while doing so should devote a part of his time to improving himself mentally, by reviewing his trip as he surely made a mental note of the bad effects on the locomotive, when certain things were done contrary to instructions, and the good effects when the work is carried out according to instructions; this is the time to resolve to discontinue doing that which produces the ill effect, and doing literally, that which produces good results. For the fireman who follows these precepts I predict an engineer that will be able to take advantage of, and handle a locomotive economically.

Now, after several years of faithful service his turn comes for promotion, and the Master Mechanic is proud to send him in for the examination for engineer, there will be no fear as to his not passing the examination; so we next find him going out on the right hand side. He will know the engine, the train number and the leaving time of his train, he will be familiar with the time card, and bulletin instructions.

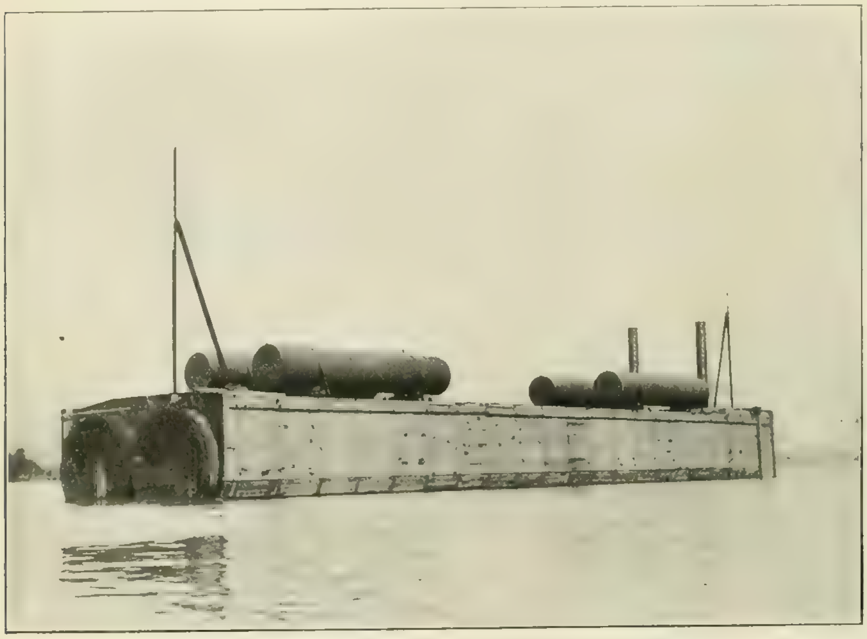


FIG. 1. THE TWIN TUBE FLOATING, READY TO BE SUNK.

He will be at his engine in plenty of time to know that she is in condition for the trip; he will know that there is plenty of water in the boiler, that the fire box is free from leaks; that his injectors work properly; that the air pump will compress the air to the required pressure, and that the gauge registers these pressures correctly, that the brakes set and release, and have standard piston travel.

He will know that rod cups are filled, and that all holes where oil is used are open so that oil can reach the bearings; he will know that set screws and bolts are tight; he will know that all lights are burning properly; he will have the maximum main drum pressure before coupling to train, and will make his light engine movements with the independent brake; he will know that he has the proper amount of supplies to make the trip; he will see to it that the fireman attends to his duties. When oiling he will see too that he uses the oil judiciously, and puts it where intended; he will know that he has the right, before pointing to the main track; he will know that he has charged and tested his brakes properly; he will know that he has sufficient amount of water in the boiler, so that he may be able to get his train well under way before starting injector; he will know that his fireman has his fire in condition to pull out with, and before starting he will know that he has the slack of the entire train bunched to the rear, so that when he starts the engine without slipping the drivers will start one car at a time; he will hook lever up toward center one or two notches at a time, as the train is forced into speed, until lever is hooked up to where engine will handle train at a speed that is consistent with the load hauled.

He will feed the water to the boiler in as near the amount that is being evaporated as consistent, allowing boiler to lose a certain amount when the strain is greatest, as he knows he can regain the amount lost, after he has tipped over the summit of the grade; in preparing to haul the maximum tonnage over the ruling grade he will have the boiler moderately full of water, so he can lose some if necessary to keep the steam up to the maximum; he will not try to take a run for a hill so far back that he will kill his engine by working her out of steam and water, before the hill is reached. When he stops his train he will do his braking as instructed; by doing this he will not have to explain why he pulled out a draw bar, and delayed an important train.

If his engine developed an unusual pound on the road, he will make an inspection in time to make repairs before he has a breakdown, thereby avoiding an engine failure, and saving himself double work, that he would have to do if he had tried to run the engine with loose bolts, keys, or wedges down; he will scan the monthly report and see to it that his performance compares with the average, in the consumption of coal and oil, as he knows that he cannot be rated as an average engineer unless his standing is with the average; in fact, he will handle the supplies and property of the company as if they were his own; he will have time to consult with his fireman, with a view of getting his cooperation to the end that each trip will be a successful one, bearing in mind that each man's record is just what he makes it; this is in the opinion of the writer the proper way to take advantage of and handle a locomotive economically.

Subaqueous Tunnel at Detroit.

Work on the under water tunnel which connects the town of Windsor in Canada with the city of Detroit in the United States goes on apace. In our September, 1907, issue we gave a very complete description of the whole undertaking. In the November, 1907, issue of Railway and Locomotive Engineering the floating off of the prepared tubes was shown, and we are now able to present to our readers a view of the twin tube sections preparatory to being sunk and also a view of the tubes partly submerged as one section was sunk into place.

The tubes are made of steel plate ⅜ in. thick, and each is 23 ft. 4 ins. in diameter. There are two tubes side by side connected by steel diaphragms or fins which extend out on all sides and stiffen the tubes as well as holding them together. The view of the tubes floating on the water shows the wooden sides which have been bolted to the outer edges of the diaphragms.

The open ends of the tubes are blocked up with wood so that both tubes are filled with air. The four tanks on top are filled with compressed air and this, with the atmosphere in the tubes and the wooden sides, keeps the whole afloat. At each end of this novel craft is a mast to assist in the correct alignment of the tubes when they come to be sunk, and the two upright tubes, which look like the smoke pipes of a steamer, are manhole tubes by which workmen can get into the tunnel tubes after they have been sunk in position. The tubes floating on the Detroit river are shown in Fig. 1.

The other view shows the tubes in the act of sinking to their final position in the ditch which has been dredged across the bed of the river. When the tubes have been towed to a position on the surface immediately above the line of the subaqueous ditch, the sinking of the tubes is accomplished by letting the compressed air gradually out of the tanks, which are carried on top. The view, Fig. 2, shows the tubes in the act of settling down, one end being permitted to go down a little ahead of the other. When the tubes are in place the tops of the manhole tubes will still be above the surface a few feet, like the smoke stacks of a steamer sunk in comparatively shallow water.

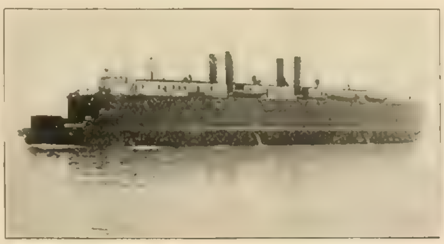
The whole enterprise has been a notable one, and the methods by which the work has been carried on are exceedingly ingenious. The tunnel will be on the line of the Michigan Central Railroad, and trains will eventually be hauled through by electric locomotives. When this is done the car ferries, which have plied between Windsor and Detroit in summer and in winter for so many years, will be superseded by an uninterrupted way which will be open at all times and unaffected by river traffic, storms, ice or the flow of the river.

FIG. 2. ACTIVE WORK. TWIN TUBE BEING SUNK INTO POSITION.
(Photo. Courtesy of Scientific American.)

A New Rotary Engine.

In the Sibley College laboratories the final perfecting work is now being done on a new steam engine which will probably fill an important place in the engineering world. This engine promises to be the first practical rotary engine put on the market, and the final experiments now being made indicate its practical use for marine purposes, with the added possibility of application to locomotive and other work.

The above paragraph is cut from a marked paper sent to us from Cornell. So many ingenious inventors have worked vainly to develop a practical rotary engine that we are pleased to find that such an engine has at last been perfected or is in the way of being made a success. We wish, however, to caution all the persons interested in this invention to refrain from using it as a locomotive until reliable starting appliances have been perfected. The immense power necessary to start a locomotive attached to a heavy train renders turbines and rotary engines useless without the addition of clutches or other apparatus to produce high tractive effort, and such things are likely to be troublesome on a locomotive. We should advise those interested in the rotary engine to make certain that it can do stationary work substantially before venturing into the railroad field.



ONE OF THE M. C. R. R. CAR FERRIES.

Departmental Co-operation.

The fact that money and time can be and is lost by the want of co-operation between railroad departments was brought clearly before the members of the Central Railroad Club in a paper recently read by Mr. Dexter C. Buell of Chicago. The title of the paper was "Some Joint Problems of the Mechanical and Operating Departments of a Railroad." The work of these two departments, Mr. Buell said, is so closely allied that in order to obtain the best results the various officials of one must work in harmony with those of the other.

First of all, there was the question of the purchase of power and equipment, and the speaker held that it is safe to say that in many instances where power has been bought without giving the officials who must use it a chance to be heard, expenditures out of all proportion to the gain from increased train haul have been made in order to keep this power in service. The same is true to a less extent as regards equipment. Ideas can be gained by getting several representative men among those who will have to use and repair this equipment to pass upon the plans.

Just here we may remark that the view expressed by Mr. Buell was put in

practical form some time ago by Mr. J. E. Mulfeld of the B. & O., who bought a sample engine, the first one of a large order, and asked for the official criticism of the engine and its work, by a committee composed of all ranks. An account of this may be found in our March, 1906, issue, page 112.

Mr. Buell remarked on the subject of power distribution on a railway that to properly assign the power the interests of the mechanical department must be considered as well as those of the operating department. A large number of railroads would be well repaid by making a thorough reassignment on a basis that included the needs of the mechanical as well as those of the operating people.

Any tonnage rating that will not allow trains to get over the road in a reasonable length of time is not only unfair but uneconomical. On the other side, careless roundhouse work has as bad an effect as too heavy a tonnage rating because it does not allow dispatchers to get trains over the road as they should.

The speaker next dealt with the buying of coal. He said that what might be ideal from the purchasing agent's standpoint might be very uneconomical under certain operating conditions. The handling of company's material is also a subject where co-operation is essential if economical results are to be obtained. In practice some one is always out of something he thinks he wants in a hurry. Much of the "emergency" handling of company's material could be avoided if only real and undoubted emergencies were permitted and when such real emergencies arose the operating department would make every concession necessary to meet the situation. He instanced the almost proverbial apathy of the yardmaster under these circumstances. This is particularly true in rush times or when a yard is congested. Company's material is often buried in a yard and absolutely no attempt is made to switch it out and place it for unloading.

The one thing, aside from engine failures, that an operating official is most ready to criticize the mechanical department for is the bad order car situation; yet in many cases a car foreman can get practically no help from a yardmaster in handling such cars, or in keeping repair tracks properly set and pulled and having cars spaced so the work can be done expeditiously.

Dealing with the situation out on the road Mr. Buell said the most common cause of friction between the two departments is over engine failures. It seems that the only way to handle this fairly is to formulate a set of rules defining just what will be charged as engine failures. This to be agreed upon by proper officials of both departments, and then those making up engine failure reports held responsible for any improper reports made.

Another common source of trouble is the practice of allowing conductors to report what is wrong with an engine. Any report of trouble with an engine or inability to handle a train properly should be made over the signature of both the conductor and the engineer.

There must be co-operation between yardmasters, dispatchers and roundhouse foremen in order to get best results in turning power quickly. It is very embarrassing to an operating man, after an investigation of a trouble, to have to admit that the fundamental cause is due to indifference on the part of some one in his own department.

Other interesting points were taken up and altogether Mr. Buell's paper is one which is full of practical truths and apt suggestions. The ultimate object of a railway which is to perform a useful service to the public and to earn money is often obscured by the desire of some official to make a "good showing" at all hazards for himself or the department immediately under his charge

STAIR BRIDGE, AYRSHIRE, SCOTLAND.

Knocks Out 2-Cent Fare Law.

The Supreme Court of Pennsylvania has affirmed a decision of the Common Pleas Court of Philadelphia to the effect that the 2-cent law passed by the last Legislature is unconstitutional. This decision ought to have a salutary effect upon the minds of rustic legislators to act on the principle that railroad companies have no rights that legislators are bound to respect. Reducing railroad fares to 2 cents a mile is in some cases pure confiscation of property without due process of law.

There was no question in Pennsylvania of the ability of the Pennsylvania Railroad Company to do the greater part of its passenger business at a maximum rate of 2 cents a mile. The company's suburban traffc charges average much less than 2 cents and it offers 1,000-mile tickets, good over all its lines, for $20. Yet it is not clear that it could make a uniform 2-cent rate on many of its branch or leased lines for local as well as for special 1,000-mile ticket traffic. Undoubtedly on some such lines the passenger would be carried at a loss, and it was a plain neglect of duty on the part of the Legislature not to recognize the inequalities in earning power between the different corporations involved. What was practically harmless, perhaps, for one was a positive deprivation of rights and property for another.

Praise From the "Thunderer."

The *Times* of London, England, which is probably the most influential newspaper in the world, has published a review of the "Development of the Locomotive Engine" to the extent of over one thousand words. It is very carefully done, the indications being that the writer read the book through. Here are two excerpts:

"While giving much space to the subject of locomotive engines, partly English, mostly American, the articles are particularly interesting for their account of the development of railways in America, so that they are instructive even to persons to whom the subject of steam engines does not necessarily appeal—that is to say with its biographical matter it is useful reading for the general public as well as for railway men.

"For the expert the book provides excellent leisure reading, and for all who study railways and railway working for profit or pleasure, the mass of practical information collected into the work is both useful and interesting."

There is for sale in the Book Department of the Angus Sinclair Publishing Company a copy of the very famous book, "Railway Machinery," by D. Kinnear Clark. The price is twenty-five dollars. The book ought to be in every library of any value for reference, yet there is not a copy in the Congressional Library of Washington.

Nearly all the railroad officials who have risen from the ranks acknowledge that while climbing laboriously up the ladder towards the upper regions, they received valuable help from the pages of Railway and Locomotive Engineering.

Items of Personal Interest

Mr. Chas. E. Fuller, superintendent of motive power of the Alton, at Bloomington, Ill., has resigned.

Mr. C. H. Seabrook has been appointed master mechanic of terminals of the Houston Belt & Terminal Co.

Mr. Isaac N. Wilber, master mechanic of the Burlington at Hannibal, Mo., has resigned after 50 years' service.

Mr. W. C. Atherton has been appointed purchasing agent of the Pere Marquette, with headquarters at Detroit, Mich.

Mr. J. L. Butler has been appointed master mechanic of the Missouri Pacific Railway, with headquarters at Atchison, Kan.

Mr. W. C. Cyr has been appointed master mechanic of the Burlington at Hannibal, Mo., vice Mr. Isaac N. Wilber, resigned.

Mr. B. D. Farwell has been appointed purchasing agent of the Buffalo & Susquehanna Railway, with headquarters at Buffalo, N. Y.

Mr. E. G. Courtney has been appointed master mechanic of the Arkansas, Louisiana & Gulf Railway, with headquarters at Monroe, La.

Mr. G. S. McKinnon has been appointed assistant master mechanic of the Canadian Northern Railway, with office at Winnipeg, Man.

Mr. M. Marea, formerly road foreman of engines of the Toledo, St. Louis & Western, has been appointed master mechanic on that road.

Mr. Eugene McAuliffe has been appointed general fuel agent of the Evansville & Terre Haute Railroad, with headquarters at Chicago, Ill.

Mr. L. G. Wallace has been appointed acting master mechanic of the Mexican Central Railway at Guadalajara, vice Mr. R. N. Millice, promoted.

Mr. T. L. Kenney has been appointed road foreman of engines for the west district of the Cincinnati, Cleveland, Chicago & St. Louis Railway.

Mr. J. E. Cameron has severed his connection with the Atlanta, Birmingham & Atlantic Railroad Company as superintendent of motive power.

Mr. J. H. Brassard has been appointed inspector of transportation on the Intercolonial Railway of Canada, with headquarters at Moncton, N. B.

Mr. W. J. Dempster has been appointed master mechanic of the Monterrey Division of the Mexican Central Railway, vice Mr. J. A. Lewis, transferred.

Mr. Charles E. Fuller, formerly superintendent of motive power of the Chicago & Alton Railway at Bloomington, Ill., has resigned from railroad service.

Mr. R. D. Gibbons has been appointed general foreman of the Mexican Central Railway, with headquarters at Saltillo, Mex., vice Mr. J. G. Smith, transferred

Mr. John G. Smith has been appointed acting mechanical foreman of the Coahuila & Pacific division of the Mexican Central Railway, vice Mr. W. C. Burel, resigned.

Mr. R. A. Weston has been appointed general storekeeper of the New York, New Haven & Hartford, with office at New Haven, Conn., vice Mr. Imley Prescott, resigned.

Mr. G. W. Dickson, formerly master mechanic of the Chicago, Indianapolis & Louisville, at Peru, Ind., has been appointed master mechanic of the Grand Trunk Railway.

Mr. K. L. Dresser has been appointed master mechanic of the Chicago, Indianapolis & Louisville Railway, with headquarters at Peru, Ind., vice Mr. G. W. Dickson, resigned.

Mr. F. J. Cole, formerly mechanical engineer of the American Locomotive Company, has been appointed consulting engineer of that company, with headquareers at Schenectady, N. Y.

Mr. R. N. Millice, acting master mechanic of the Mexican Central Railway at Guadalajra, has been appointed master mechanic on the same road, vice Mr. R. D. Gibbons, transferred.

Mr. R. K. Oliver, heretofore general foreman at McAdam Jct. on the Canadian Pacific, has been appointed master mechanic on the Lake Superior division of the same road.

Mr. Carl J. Mellin, formerly designing engineer of the American Locomotive Company, has been appointed consulting engineer of that company, with headquarters at Schenectady, N. Y.

Mr. C. S. Weston has been appointed superintendent of the Southwest Division of the Chicago Great Western Railway, with headquarters at Des Moines, Ia., vice Mr. C. L. Nichols, resigned.

Mr. C. T. Banks has been appointed superintendent of the W. M. & P. Division of the Chicago Great Western Railway, with headquarters at Red Wing, Minn., vice Mr. C. S. Weston, transferred.

Mr. H. C. Woodbridge, formerly master mechanic of the Buffalo, Rochester & Pittsburgh Railroad, has been transferred to Du Bois, Pa., to do special work for the superintendent of motive power.

Mr. J. Kyle, heretofore assistant master mechanic at Winnipeg on the Canadian Pacific, has been transferred in a similar capacity to the Regina branch, with office at Edmonton, Alta.

Mr. Harry Walker, a locomotive engineer on the Pocahontas division of the Norfolk & Western, has been promoted to be assistant road foreman of engines on the same division of that road.

Mr. R. G. Gilbride, formerly locomotive foreman on the Grand Trunk at Palmerston, Ont., has been appointed round house foreman on the Central Vermont Railroad at White River Jct., Vt.

Mr. Harvey Halverson, formerly foreman of the coach department of the Wisconsin Central Railway, has been appointed master car builder on the same road and at the same place, vice Mr. William Percy, resigned.

Mr. T. L. Burton has been appointed general inspector in charge of air brake, steam heat and car lighting equipment on the Central Railroad of New Jersey, and will perform such other duties as may be assigned to him.

Mr. F. L. Woolwine, assistant road foreman of engines on the Pocahontas division of the Norfolk & Western, has been transferred to the Kenova division as general road foreman of engines on the same road.

Mr. J. H. McGoff, formerly master mechanic of the Missouri division of the Santa Fe at Fort Madison, Ia., has been appointed mechanical superintendent of the Eastern grand division on the same road with office at Topeka, Kan.

Mr. W. P. Chrysler, formerly master mechanic of the Chicago Great Western at Oelwein, Ia., has been appointed superintendent of motive power of the same road, with headquarters at Oelwein, Ia., vice Mr. J. E. Chisholm, resigned.

Mrs. A. Fenton Walker, who represents in this country and Canada the Directory of Railways of the World, has been in an hospital for two months, but has now recovered and will be found in her office at 148 Liberty street, New York.

Mr. C. H. Osborn, formerly division foreman of the Chicago & Northwestern at Fond du Lac, Wis., has been appointed master mechanic of the Madison division of the same road, with headquarters at Baraboo, Wis., vice Mr. W. H. Huffman, resigned.

Mr. M. J. McCarthy, formerly master mechanic of the Michigan Southern di-

vision of the Lake Shore & Michigan Southern Railway, has been appointed superintendent of shops of the Cleveland, Cincinnati, Chicago & St. Louis, at Beech Grove, Ind.

Mr. William Alderson, general car inspector of the Grand Trunk Railway, has retired from the company's service after many years' faithful service. Mr. Alderson sustained severe injuries in the wreck at Guelph last March, and is still suffering from its effects.

Mr. D. E. Gardener, road foreman of engines on the Kenova division of the Norfolk & Western, has been transferred as general road foreman of engines to the Pocahontas division of the same road, vice Mr. John Culliney, assigned to other duties.

Mr. Peter Maher, superintendent of motive power of the Toledo, St. Louis & Western Railroad, will now hold the position of superintendent of motive power of the Chicago & Alton Railroad as well as of the Toledo, St. Louis & Western, as the latter road has acquired the former.

Mr. E. T. James, general foreman of the New York, New Haven & Hartford Railroad, has been president of the Central Railroad Club of Buffalo for the past year. At the last annual meeting of the club Mr. James was presented with a past president's badge made of gold. The occasion called forth some exceedingly flattering encomiums upon Mr. James' zeal in carrying on the work of the club.

Mr. A. E. Robins has resigned from the Gold Car Heating & Lighting Company, to take a prominent position with the Ward Euipment Company of New York. Mr. Robbins is well and favorably known to a very large number of railway officials and supply men throughout the United States and Canada. He has been remarkably successfuly in the railway supply business and every indication points to his continued and still greater success with the Ward Equipment Company.

Mr. James Coleman has been appointed superintendent of the car department of the Grand Trunk Railway at Point St. Charles, Que., vice Mr. McWood, retired. Mr. Coleman was formerly on the Central Vermont, on which line he occupied the position of superintendent of the car department for some years. He was at one time superintendent for the Canada Car Company in connection with the company's works, but after serving two years in that capacity, he returned to his old position on the Central Vermont. Previously he served for some years as general foreman of the G. T. R. car department at Chicago.

Mr. J. Gibson has been appointed locomotive foreman of the Grand Trunk Railway at Brockville, Ont., vice Mr. J. E. Rugg, assigned to other duties. Mr. Gibson began railroad work as an apprentice on the Caledonian Railway in Scotland, which was also Mr. Angus Sinclair's first railway. Mr. Gibson remained with that company for 15 years, after which he went to the Londonderry & Lough Swilly Railway shops as foreman and later became superintendent of motive power. He was also engineer on the P. & O. steamships between India and Australia. He came to Canada in 1907 and entered the service of the Grand Trunk system at Belleville, Ont.

President Delano of the Wabash has denied rumors persistently circulated that he intended to retire from the management of that railroad. President Delano has been exceedingly successful in the management of the Wabash, and the company has been able to pay 3 per cent. on the debenture A bonds. Mr. Delano says that the business is satisfactory in view of the general railroad conditions, and that the grain movement was larger than at this time last year. He expressed himself as hopeful regarding the future, but intimated that it would take a little time before business and financial conditions were fully adjusted.

Mr. William McWood, superintendent of the Grand Trunk Railway car department, has been retired under the pension rules of the company. Mr. McWood was born in Montreal, in 1830, and served an apprenticeship with John Thornton, coach builder. He entered the service of the Grand Trunk in 1855, and from 1860 to 1873 was foreman of the road. He had been assistant mechanical superintendent and superintendent of the car department, in charge of the car department of the entire line, since 1873. He has been a member of the Master Car Builders' Association since 1875, and was vice-president of the association from 1882 to 1887. He was chosen president of the association in 1887, and held that position for three years.

Mr. John Stewart has been appointed traveling inspector of locomotives and cars on the Intercolonial Railway of Canada, with headquarters at Moncton, N. B. The appointment of Mr. Stewart is very popular among the employees. Our agent at Moncton writes us concerning this appointment that all rejoice at Mr. Stewart's advancement, but that "in his retirement from the secretaryship of the Grand Board of Adjustment of the B. of L. E. on the Intercolonial and the Prince Edward Island Railways the enginemen are losing an earnest advocate of all that was honorable and just, and while sincerely regretting the loss to the organization here, every engineman feels that no person on the system is better qualified to fill the position."

Mr. William Cross, who has been in the service of the Canadian Pacific Railway for twenty-five years and latterly in the important position of assistant to Mr. William Whyte, second vice-president of the company, at Winnipeg, has retired from active service, and the office of assistant to the vice-president has been abolished. In its place, a new office has been created—that of superintendent of motive power of western lines. Mr. Cross is well known in Montreal, having served the company in that city from 1901 to 1904, as engineer of tests. During his long connection with the C. P. R., Mr. Cross has seen service on nearly every one of the many divisions of the road, and a more zealous and better known officer of the mechanical department it would be hard to find.

Mr. H. W. Clapp was recently tendered an informal luncheon at the Engineers' Club in New York by some of his business friends in this city. He has accepted a position in the electrical organization of the Southern Pacific Company, and will shortly remove to San Francisco, and his friends took this occasion to express their regret at his departure from New York and to wish him success in his new field. Mr. Clapp has given particular attention to the installation and operation of the rolling equipment used in the electrification of the New York Central Railroad and to the cars for the Interborough Rapid Transit Company's system. He also equipped the cars for the West Jersey & Seashore Railroad, which it will be remembered was an installation of peculiar interest, because of the short time in which the contract was executed. Mr. Clapp has had long experience in railway matters. He is a son of F. Beardman Clapp, managing director of the Melbourne (Australia) Tramway and Omnibus Company. Before coming to America he was for four years superintendent of motive power of the Brisbane Tramways Co., of Brisbane, Australia.

Mr. Grant Hall has been appointed superintendent of motive power on lines west on the Canadian Pacific Railway, with office at Winnipeg, Man. This is a new position which has just been created. Mr. Hall was born in Montreal and served his time as machinist in the Grand Trunk shops at Point St. Charles, Que. He entered the service of the Canadian Pacific in 1886, and from then until 1893 acted in the capacity of machinist and locomotive foreman at Montreal. From 1893 until 1898 he was employed as general locomotive foreman on the Intercolonial at Moncton, N. B. At the end of that time he returned to the service of the C. P. R., and from 1898 to 1904 was successively locomotive foreman at Montreal; general foreman at McAdam, N. B.; general foreman at Winnipeg; master mechanic of the Pacific division, with headquarters at Revelstoke, B. C.; and assistant superintendent of motive power,

Eastern lines, Montreal. In 1904 he was appointed assistant superintendent of motive power at Winnipeg, and has held that appointment from then till the present time. In his new office he will have charge of all rolling stock from Fort William to the Pacific Coast.

Mr. P. H. Houlahan, general superintendent of the Toledo, St. Louis & Western, has had his jurisdiction extended over the Chicago & Alton which has come under the control of the Clover Leaf Company. Mr. Houlahan, a most able, practical railroad man, has also interested himself in the education of brakemen and other trainmen. He has done for brakemen services similar to those done by Sinclair for enginemen. Mr. Houlahan began his railroad career in 1867 as water boy on construction of the Ottawa, Oswego & Fox River Valley Railroad, afterwards absorbed by the Chicago & Alton. When strong enough he went to work on the track and moved ahead through the positions of check clerk, station baggage master and ticket agent. Then he took to train service, wishing to master the whole business, and was from 1875 to 1881 first brakeman, then conductor, on the Fox River branch. Then he commended himself trainmaster, and got there, first as assistant, then as full fledged trainmaster of the St. Louis division of the Burlington. In 1886 he became master of transportation of the Missouri & Kansas division of the St. Louis, Arkansas & Texas, but stayed there only six months when he accepted the position of trainmaster of the Hannibal & St. Joseph. He rose then to be superintendent and left it to be general superintendent of the Clover Leaf, where he still remains with extended honors and responsibilities.

The Falls Hollow Staybolt Company of Cuyahoga Falls, N. Y., have got out a very artistic calendar for 1908. It is in fact a colored reproduction of the famous painting by Franz Charlet, called "The first days of spring." The picture is brimful of life. The call of the season has come to three little fellows in a Belgian fishing town. One of them has sniffed at something in the breeze, and suddenly there is in him no desire so keen as that to hunt up his top, which all winter has lain forgotten among his possessions. He passes the word along to a chum. The sport is on, and the brick paved wharf soon beholds a little group of boys in bright colored jackets, balloon-like trousers and wooden sabots, spinning their brightly painted tops. The Falls Hollow Staybolt Company are to be congratulated upon the useful reminder they are sending out to their friends.

Matthias Nace Forney.

Matthias Nace Forney, the famous mechanical engineer, journalist and author, died at New York on January 14 after an attack of paralysis, aged 73 years. He was born at Hanover, Pa., in 1835 of German ancestry, the progenitors of the family in America having come to this country in 1721.

His father died when Matthias was 12 years old, leaving the mother with three sons and three daughters. Hanover having had at that time very indifferent school facilities, Matthias was sent to school in Baltimore which had something of a high school character. He early displayed a strong tendency towards mechanism and science, one of his earliest ambitions having been to make a steam engine. With such tastes it was not surprising to find that he entered the shops of the great pioneer locomotive builder as an apprentice in 1852. He spent three years working in the shops and one year in the drawing office. At the end of his apprenticeship he obtained a position as draughtsman in the shops of the Baltimore & Ohio, then in charge of Henry Tyson. He remained in that position three years.

THE LATE M. N. FORNEY.

Thinking that prospects of success in life were very meagre on railroads, Mr. Forney left railroad work and entered mercantile business in Baltimore. But the attractions of machinery were upon him and three years of business found him ready to return to his first love. The resulting change was to enter the employ of the Illinois Central as draughtsman under Samuel J. Hayes, superintendent of machinery.

In the course of an autobiography presented to the New York Railroad Club in 1902 Mr. Forney said concerning the Chicago period of his career:

"During my employment on the Illinois Central Railroad their shops were located in Chicago near where the present passenger station now stands. To show how slight events sometimes lead to more important ones, it will be explained that my boarding place was then in Wabash avenue, near Washington street, a locality now covered with sky-scrapers, and my daily walk was on Michigan avenue to and from the shops. The track of the Illinois Central Road then extended on piling over the lake, and from the shops to the station, which was then about a mile farther north. There were at that time on the road some four-wheeled switching engines which weighed about 20 tons and had four-wheeled tenders. These engines would pull as heavy a train as the heavier eight-wheeled "American" engines with four coupled wheels and weighing 30 tons. In my daily walks in pursuit of Chicago nutriment, I saw these switching engines backing up to the shops on the track which was in plain view. The question consequently occurred to me, 'If the little engines will pull as much as the big ones, why are the little ones not used in general road service?' As the road in this location was in plain view from Michigan avenue, and the engines and tenders showed distinctly in side elevation while running to and fro, it was apparent that having a short wheel base they were very unsteady. The idea then occurred to me why not connect the engine and tender by a rigid frame and put a truck under the tender? This would give a long wheel base with steadiness, and retain the whole weight of the boiler and engines on the driving wheels for adhesions. This was the origin of what has since been known as the 'Forney' engine, of which the annexed figure is a representation."

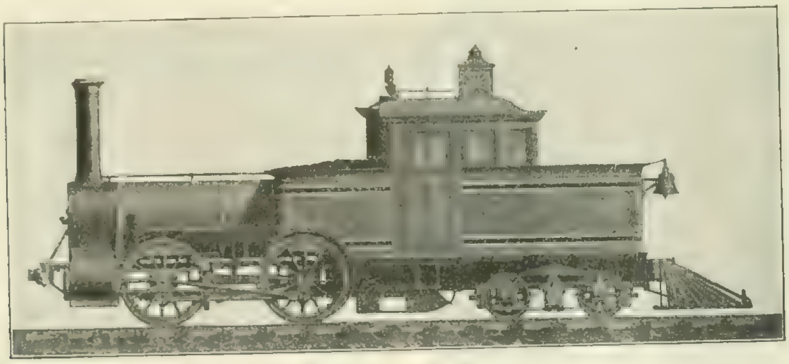
After some persistent efforts Mr. Forney and his friends succeeded in getting Forney locomotives placed upon the elevated railroads in New York and they operated so successfully in that service that they became the motive power for all the elevated and many surface suburban railroads. They held constant favor for that work until they were displaced by electric motors.

After serving the Illinois Central for three years Mr. Forney went to be draughtsman with the Detroit Iron & Bridge Works, but remained there only a short time, having been engaged by the president of the Illinois Central Railroad to superintend the building of some locomotives under construction at Hinkley & Williams Works in Boston. This was in the spring of 1865, and occupied Mr. Forney about six

months. On the completion of the engines Mr. Forney remained with Hinkley & Williams about three years as mechanical engineer and agent.

When the inspiration is given a person to express thought and ideas in writing the tendency to do so will not long remain suppressed. The journalistic faculty permeated Mr. Forney's mind and for a time he obtained vent for his thoughts through various railroad and engineering publications, particularly the *Railroad Gazette*. This led him in 1870 into negotiations with the *Gazette* for a position on the staff and he was appointed associate editor, the paper being then published in Chicago. The great fire occurred there the following year and the headquarters of the *Railroad Gazette* were moved to New York, Mr. Forney having bought a half interest in the property. His work very quickly brought the *Railroad Gazette* to be recognized as the best authority in the world on railroad mechanical engineering. He began writing what is known as The Catechism of the Locomotive in 1873 and it was pub- that was always comprehensible. Mr. Forney's writings always possessed a streak of humor that enhanced their charm. When Angus Sinclair was writing his book on the Development of the Locomotive Engine, he wrote asking Mr. Forney to send his portrait. In replying Mr. Forney wrote: "I have been waiting for several years past to get sufficiently good looking so as to have a better picture made. Since my long illness of last summer my friends tell me I am looking better, but, alas, none of them say I am better looking." When he sent a picture a few weeks later, he wrote: "The photographer struggled hard to make a handsome picture, but, as you will see, he did not succeed. The worst of it is that the picture looks like me."

As editor of the *Railroad Gazette* Mr. Forney never failed to tell the truth about the engineering heresies and humbugs that were coming to public notice periodically. The narrow gauge fallacy, the Fontaine locomotive idiocy and many other freaks had their day of popularity shortened by Mr. For-



LIGHT LOCOMOTIVE FROM ORIGINAL DESIGNS BY M. N. FORNEY.

lished in his paper in serial form and afterwards put out in book form. It was rewritten ten years later, and the author was engaged rewriting it at the time of his death.

Besides his well known locomotive, Mr. Forney was the inventor of many devices, mostly for railroad purposes. In the autobiography already referred to he says:

"Invention has always had a great fascination for me as it has many others. It is akin to the passion which the fatuity of gambling has to a gamester, and once having developed the taste for invention, its allurements have led me on, as will be shown by the following list of patents which have been granted me." Then follows a list of thirty-three patents, most of them for improvements on the locomotive.

Matthias N. Forney was a fertile inventor and an accomplished designer of railroad appliances, but his fame well rests upon his work as an engineering journalist and author. Besides possessing the faculty of clear, lucid diction ney's incisive analysis and scathing ridicule.

In 1883 Mr. Forney left the editorial chair of the *Railroad Gazette*, realizing that he was overworking himself. A few months before taking this step he asked Angus Sinclair to become his assistant, but that gentleman was working on another paper under a time engagement. Mr. Forney frequently said that had he secured Mr. Sinclair as an assistant he would have remained with the *Gazette*.

Through his influence the Master Car Builders' Association was reorganized and Mr. Forney became secretary, holding the position for several years. Three years after quitting the editorial chair, the allurements of journalism overpowered his senses and he bought the *American Railroad Journal & Van Nostrand Engineering Magazine*, consolidating them under the name of the *American Engineer & Railroad Journal*. That enterprise did not prove successful and he subsequently sold the property to Mr. R. M. Van Arsdale, who in-

corporated the paper with the *National Car & Locomotive Builder.*

Mr. Forney made some flights into the realms of politics, and published several books and pamphlets of a political character. But his great work is the Catechism of the Locomotive. That has been an instruction book for several generations of railroad men and will hold a high educational position as long as steam locomotives remain in use.

Dr. Coleman Sellers.

With the death of Dr. Coleman Sellers which occurred at Philadelphia on December 28 the country has lost one of the most eminent engineers that the American continent has produced. Railroad engineering has lost one whose actual experience bridged the span between the primitive forms of motive power and the modern locomotive that seems to have reached the limit of weight and power.

Coleman Sellers was born in Philadelphia January 28, 1827. He belonged to a race of mechanics, a party of whom came from Derbyshire, England, with William Penn. The Sellers drifted into various industrial lines in which they have always been celebrated for superior mechanical ability. Coleman Sellers, Sr., the father of Coleman under notice, carried on an engineering business in Philadelphia. In 1835 the firm built two locomotives for the Philadelphia & Columbia Railroad which had several original features, among them counterbalance in the driving wheels. Coleman Sells, Jr., was too young to take part in the building of the Philadelphia & Columbia Railroad locomotives, but his sympathies seem to have been early turned in the direction of locomotive building, for in 1851 he accepted a position as foreman in the Niles Locomotive Works of Cincinnati, where he remained five years. That position he relinquished to take charge of the drafting office of his relatives, William Sellers & Co., Philadelphia. Realizing that railroads needed better machine tools than they had previously been supplied with, Mr. Sellers devoted much time and attention to designing tools for locomotive work, and many of the magnificent line of tools now in use in railroad shops have been due to his initiative. Dr. Sellers was a fertile inventor of mechanical appliances, his productions in this line covering a wide field.

THE LATE DR. COLEMAN SELLERS.

He was one of the charter members of the American Society of Mechanical Engineers and was president 1885-6. He was a member of many other engineering and technial societies and the highest of them delighted to honor this distinguished engineer. The honorary degree of Doctor of Engineering was conferred upon him in 1887 by the Stevens Institute of Technology, Hoboken, N. J.

Of late years Dr. Sellers has been closely identified with the Cataract Construction Company of Niagara Falls. Through his influence the alternating current was adopted against the recommendation of other eminent electrical engineers and they all came to acknowledge that Dr. Sellers had been wise in his recommendations. He devised the appliances for adjustment of dynamos which has held the admiration of the electrical world.

Dr. Sellers put his hand to many lines of engineering work and in all of them demonstrated himself to be a master.

Robert McKenna.

Robert McKenna, formerly master car builder of the Delaware, Lackawanna & Western, recently died at his residence in Scranton, Pa. Mr. McKenna was born in Girvan, Ayrshire, Scotland, eighty-two years ago. At the age of fourteen, he entered upon an apprenticeship of seven years, learning the trade of pattern maker and joiner. At the age of twenty-three he came to America and worked at pattern making, in New York City, until April, 1853, at which time he accepted a position as pattern maker with the Hudson River Railroad Company. Two months after entering the employ of the company he was made foreman of the car shops, which position he held until June, 1870, when he was appointed master car builder of the Lackawanna. He took charge of the company's extensive car shops in Scranton. He held this position until failing health and his increasing years made it necessary for him to relinquish his duties. The position of M. C. B. is now held by his son. Mr. McKenna was an active member of the

Master Car Builders' Association, having joined shortly after its organization. He was a life member of the association. During the years that he served as master car builder he designed many of the cars which are at present in use on the road. As a designer and mechanical draughtsman he had few equals.

The E. H. Mumford Company, of Philadelphia, Pa., has acquired by purchase all the patent rights, molding machines and equipment of Ph. Bonvillain and E. Ronceray in the United States and have added to their own molding machine line these other and efficient French machines and pattern processes. The offices of the E. H. Mumford Company have been removed from 17th and Callowhill streets to 1315 Race street, Philadelphia, where the French machines have been, for some months, installed as a working exhibit, and where they may be seen by those who desire to make a personal examination of the machines and have the process explained to them. Information will also be gladly sent by mail to those who write to the Mumford Company.

One of the neatest little folders we have seen in a long time came to us through the mail a short time ago. We can quote the whole folder right here and you won't get wearied reading it either. It says: "Do you know of any argument in favor of a weld? If not why not use the Seamless Detroit locomotive flue made from cold drawn open hearth steel? The highest product of this steel age. Do you realize that in a locomotive containing 330, sixteen-foot welded flues, a weld one mile long is in constant service." The folder is artistic and is an effective presentation of the subject. Write for one and judge for yourself. Address the Detroit Seamless Tubes Co., Detroit, Mich.

Fire at Elkhart Shops.

The readers of RAILWAY AND LOCOMOTIVE ENGINEERING will regret to hear that the magnificent roundhouse of the Lake Shore & Michigan Southern Railroad at Elkhart, Ind., was partially destroyed by fire on the morning of Jan. 9. A member of our editorial staff visited these fine shops a few weeks before the occurrence, and a description of the roundhouse, which was one of the best in the country, is printed in another part of this issue. It appears from the reports at hand that a laborer went into the lubricant room to procure a can of crude oil. An explosion occurred and in an incredibly short space of time the oil room and tool room were on fire and several sections of the roundhouse. The fire department was promptly on hand, and the action of the railway men was beyond all praise. A number of engineers at the risk of their own lives brought their locomotives out through the flame encircled buildings, one of the engineers, Mr. James Monks, and his fireman, Mr. A. B. Martin, sustained severe burns, from which they have recovered. A fine young lad, William Schemberger, who was employed as a counter boy, being in the oil house at the time of the explosion, his clothing took fire, and he expired before the fire could be extinguished.

Mr. O. M. Foster, who was recently promoted to the position of master mechanic, Mr. Bickel, road foreman of engines, and others of the official staff were promptly on the ground directing the details of the reconstruction work as soon as the fire was under control. Although a number of the best locomotives were damaged the road was not in any way crippled, the company having a reserve supply of engines.

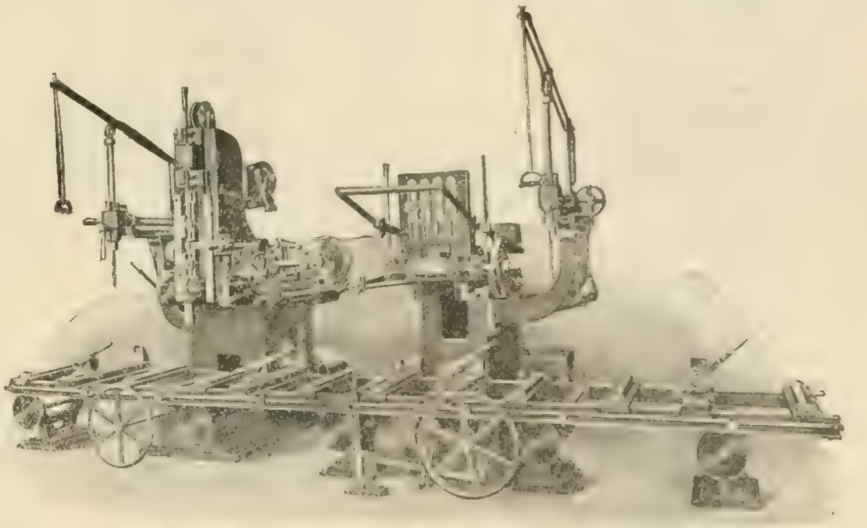
The damage to a number of the engines was speedily repaired.

EXTERIOR OF THE BURNED ROUNDHOUSE, L. S. & M. S., ELKHART, IND.

New Car Shop Tools.

Two new wood-working car shop tools have lately made their appearance. They are got out by the J. A. Fay & Egan Co., of Cincinnati, Ohio, and have just been put on the market during the past three months. The No. 150 automatic car gainer, which is one of them, has capacity for timbers up to 20 ins. thick and 24 ins. wide. The gaining arbor and head of this machine are supported on a large and powerful automatic ram, gibbed to the top of the column in planed ways, having a transverse travel of 26 ins. The arbor frame is gibbed to the front of the ram and has a vertical adjustment of 21 ins. To facilitate the adjustment, this arbor frame is counterbalanced. The machine is fitted either with a stationary or a traveling table. The stationary table is furnished with geared rolls to facilitate moving heavy material, and the traveling carriage is operated by rack and pinion.

The No. 214 hollow chisel mortiser, the other tool, is a very heavy machine and is guaranteed to do rapid and accurate work.



COMBINATION HOLLOW CHISEL MORTISER AND AUTOMATIC CAR GAINER.

The automatic ram is gibbed to a very heavy housing, moving in planed ways on the top of the column and it has a vertical travel of 18 ins. The housing has a transverse movement of 18 ins. The two heavy auxiliary boring attachments angle to 30 ins. in either direction. They have a transverse movement the full width of the table and a stroke of 18 ins. The tables described above are applicable to this machine. Some car shops require both of these machines set side by side with a single traveling carriage, so that mortising and gaining may be done on a piece of material without moving it from one machine to the other. This is a great convenience, as our illustration will clearly indicate.

For further particulars concerning these tools write direct the manufacturers.

The Gould Coupler Company, of New York, have just issued a finely illustrated catalogue, No. 4, showing the details of the "Crown" body and Trunk bolsters, many thousands of which are now in service. The bolster, it is claimed, contains many advantages, its crown-like formation giving to it an element of flexibility which insures a longer period of service. The most prominent feature of the bolster is the fact that the side bearings, center plate and dead lever fulcrum bracket can be cast integral with the bolster, thereby obviating the construction of the separate parts as well as the bolting and riveting them together. In other words, the reduction of the number of parts and the elimination of setting up work are features which will commend themselves to railroad men everywhere. Write to the company direct and they will send you the catalogue.

The Hicks Locomotive and Car Works, of Chicago Heights, Ill., have issued a circular showing the railroad equipment which they have on hand at the present time for sale. There are fifteen rebuilt locomotives of various types from switchers to consolidation. Nine rebuilt passenger coaches and a number of box and flat cars. Those requiring equipment of this kind ought to write to the Hicks Works for the circular, which gives full particulars of the stock on hand. Specifications and prices will also be mailed on request.

New Form of Shaft Coupling.

A new shaft coupling, known as the Hendershot coupling, is being placed upon the market by Messrs. Manning, Maxwell & Moore, Inc., of 85 Liberty street, New York. This device, we are told, possesses several new features. The general appearance of the coupling is shown in Fig. 1. The component parts are shown in Fig. 2 and in Fig. 3 the method of application is apparent.

Two short taper compression sleeves

are provided, marked S S in Fig. 2. These make it possible to put the two halves of the coupling in place while the shafting is upon the floor, so that it may be hoisted into position and bolted together as easily as the old fashioned plain flanged coupling. The shells A and B, Fig. 2, contain cast lugs which, interlocked, form a clutch which takes the strains upon the shells. This relieves the bolts of all shearing strains and makes a rigid and durable connection.

Although the bolts are relieved of shearing strains, about 50 per cent. more of them than usual are used. This is in keeping with the very large compression area of this style of coupling and the unusually large factor of safety provided. In applying the coupling, the shells A and B are slipped upon the shafting first. Then the sleeves S and S are put in place so that the shells may be drawn over them. The lugs of shells A and B are brought into the interlocking position and the shells are bolted together. The digits 3 and 4 practically true up the coupling, but perfect alignment is assured by keeping the two faces 1 and 2 parallel.

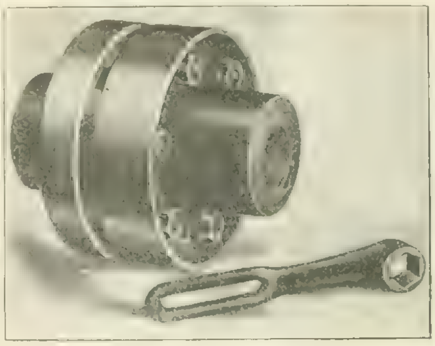


FIG. 1. HENDERSHOT SHAFT COUPLING.

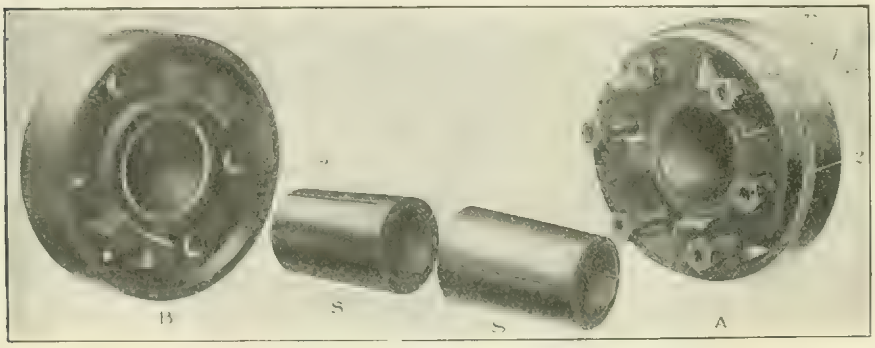


FIG. 2. DETAILS OF THE HENDERSHOT SHAFT COUPLING.

The coupling is easily taken apart by screwing two bolts in holes that are tapped in the shell for the purpose. While in coupling shafting together this construction saves time. The manufacturers are sure this feature will meet with the approval of millwrights and mechanics, who have had experience in coupling shafting with compression couplings of the single sleeve type. It should appeal to shop men, as the time saved is quite an item.

If the shafts, to be coupled, vary a little in size, or are a little out of line, or both, this coupling will adjust itself, and the compression will be the same along the full length of the sleeve. The

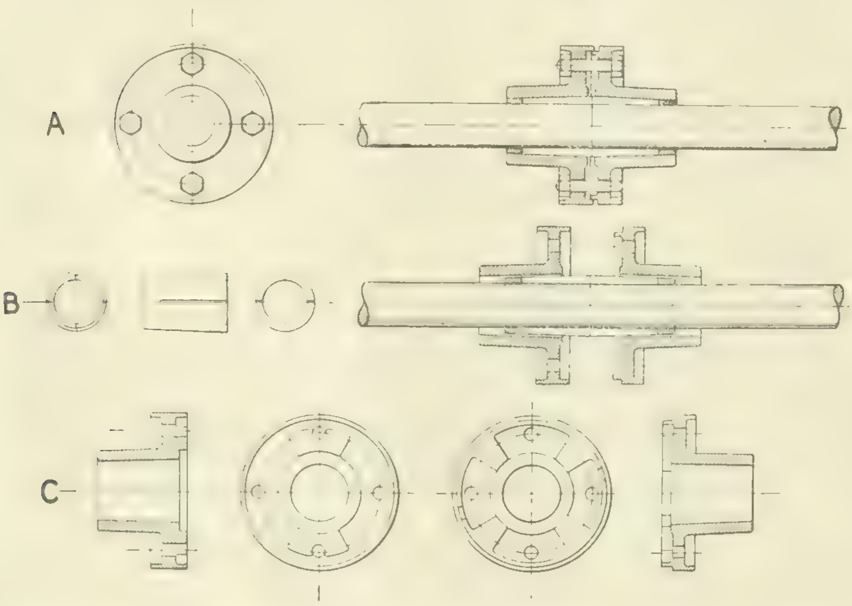
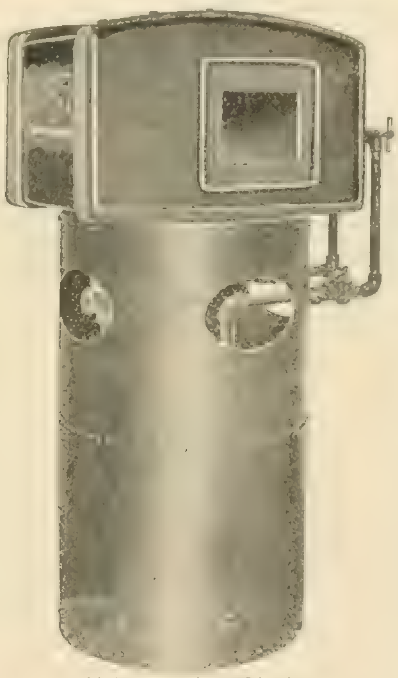


FIG. 3. METHOD OF APPLICATION OF THE HENDERSHOT SHAFT COUPLING.

sleeves are made thinner and the hubs heavier, thereby greatly increasing the strength without increasing the outside diameter of the coupling. The coupling is made of the best gray iron, and is heavy enough to withstand the strains imposed. Every coupling is put together on a test pin and inspected before it leaves the factory.

New Oil Furnace.

There is on the market a very handy line of shop tools in the shape of oil rivet forges made by Walter Macleod & Co., of Cincinnati, Ohio. What the makers call type A is a forge which will heat rivets of all sizes up to and including 5/8 in. It burns refined kerosene oil and is useful where compressed air is not available. It can be used in tempering, annealing and hardening light forgings.



PORTABLE OIL FORGE.

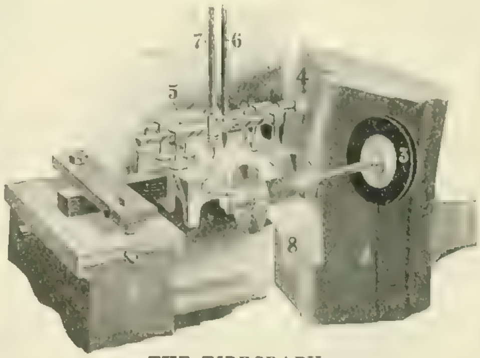
Type B is a larger forge; it is portable and is supplied with its own oil tank. It may be quickly connected to the shop air pipe system with hose and will burn either refined or crude oil and heats all sizes of rivets. Type C is not portable and is connected permanently to the shop air system and is supplied with oil from a central tank conveniently placed in the shop. A neatly illustrated catalogue No. 81 has been got out by the makers, in which each of the types of Buckeye rivet forges is described. This folder will be sent to any one who writes direct for one. The company's address is 213 East Pearl Street, Cincinnati.

The highest tide in the world is in the Bay of Fundy, between Nova Scotia and New Brunswick. The tide there sometimes rises to the height of 71 ft., and the increase is occasionally as much as a foot every five minutes.

The Tiregraph.

The Tiregraph is the name of a unique little machine that has just been invented and is now being placed on the market. It can be connected to the tool post of a driving wheel lathe and it records, on a narrow strip of paper, the exact condition of the tread of the wheel. By its use the cause of tire wear can be ascertained, and from it, the manufacturers state, they have found that nearly all unequal wear of tire treads bears a fixed relation to the weights within the wheel centers, and that if the wheel is short of counterbalance the tire will be worn most near the crank pin, and if over-weighted it will be worn most near these weights.

A Tiregram or record card can be made from each wheel of a locomotive, and by comparison with each other the cause of wear can be determined, and a remedy may then be applied. If one tire has worn more than the others all have to be turned down to its diameter, thus incurring unnecessary loss, and if the cause of such wear is found and removed, the tire will not cause this expense a second time, but will go back into service prepared to give proper results.



THE TIREGRAPH.

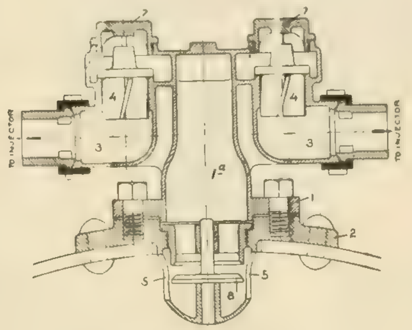
The distribution of the weights in the wheel centers can be established by this machine, also incorrect valve settings, soft spots, slid flats and the results of careless handling of the engine may be discovered which will enable the shopmen to apply the proper remedies to guard against a repetition. The Commonwealth Steel Company, St. Louis, Mo., are introducing this machine and report a most satisfactory acceptance of it by the railroads, and especially by shopmen.

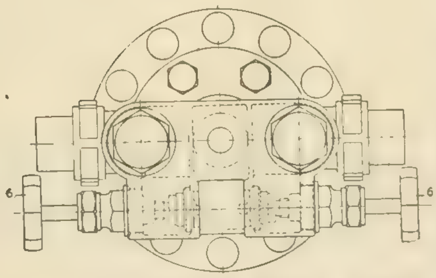
Phillip's Double Check Valve.

In our chart of a consolidation or 2-8-0 engine just issued and for which there has already been a heavy demand, there is shown a check valve on top of the boiler placed back of the smokestack. This is the Phillip's double boiler check valve, made by the Nathan Manufacturing Company of 85 Liberty street, New York. Some of the advantages claimed for this form of valve are enumerated in the

answer to question No. 7 in this issue.

Speaking of the Phillip's check valve the makers say: "This check valve is designed to be placed on top of the boiler, and for this purpose it consists of a flanged body part 1, which is bolted to the boiler flange 2, which again is riveted to the boiler shell, as indicated in the sectional view. The body is provided with two branches 3 and 3, distinct and separate from each other; each of these branches connects with one delivery pipe from each injector. These branches are provided with check valves 4 and 4, which operate in the usual manner, and through which the water is delivered into the common centre chamber 1a, of the body, and from there it passes into the boiler through openings 5 and 5, in the depending portion of the boiler flange 2. Each side of the check valve is provided with a shut-off valve 6,





PHILLIP'S DOUBLE BOILER CHECK

which in ordinary operation is wide open. If either of the check valves 4 and 4 is to be inspected or repaired this can be done with pressure on the boiler, by closing the corresponding stop valve 6. After so doing, the cap 7 of the check valve to be inspected or repaired may be removed and the valve repaired. The boiler flange is provided with a safety check valve 8, which closes automatically in case any break should occur in any part of the boiler check above flange connections.

"The claim made for this boiler check is, that being placed on top of the boiler, and the valves not coming in contact with the water in the boiler, they will not be incrustated or affected by any impurities in the water, and therefore the checks will wear better, their life is lengthened, and regrinding and other repairs are reduced to a minimum."

General Foremen's Association.

The International Railway General Foremen's Association are striving in every possible way to secure a large attendance at the next annual convention of the association which will occur at Chicago, at the Lexington Hotel, May 25th to 29th inclusive.

E. F. FAY,
President, General Foremen's Assn.

Mr. E. F. Fay, the energetic president of the association, informs us that to assist in securing a larger attendance than heretofore the executive committee and the president have decided to request the superintendents of motive power of the various railroads in the United States and Canada to allow their men to attend the convention, paying for time lost and expenses. We trust that these officials will be enabled to see their way clear to do this, believing that the educational benefits derived and which must redound to the welfare of the company or corporation which the attending member represents, will more than repay them for the monetary outlay.

TOPICS FOR DISCUSSION.

1. The pounding of the left main driving box in preference to the right.—What causes the pounding and how could it be avoided?

C. H. Voges, N. Y. C., Bellefontaine, Ohio.
E. R. Berry, C., B. & Q., Galesburg, Ill.
W. H. Kidneigh, U. P., Grand Island, Neb.

2. Modern Shop Construction—Cross pits or longitudinal?—Location of wash rooms and lavatories.—Best location for each department.—Care of shop order material and convenience of storage.

S. R. Bryan, D. & R. Iron Range, Two Harbors, Mich.
D. E. Barton, Santa Fe, Topeka, Kan.
L. R. Laizure, Erie, Hornell, N. Y.
R. F. Fay, U. P., Denver, Col.

3. Reporting work vs. engine inspection.—Should either be discontinued or are both methods essential?

E. B. Moore, U. P., Cheyenne, Wyo.
G. F. B. Warm, Frisco, Fayetteville, Ark.
A. E. Thomas, C. O. W., Oelwein, Ia.
J. C. Wilkinson, C., R. I. & P., Chawnee, Okla.
E. B. Turner, C. & R. I., Danville, Ill.

4. The apprentice question.—How can we obtain the right kind of material and how can we keep them interested?—The benefit of night schools for apprentices maintained at company's expense.—Does company obtain sufficient benefit to warrant this expenditure?

A. O. Berry, L. S. & M. S., Collinwood, Ohio.
M. J. Carrier, Erie, Huntington, Ind.
W. C. Groening, Pere Marq., Grand Rapids, Mich.
W. G. Lanmeur, N. & S., Norfolk, Va.
W. Pohleman, N. Y., O. & W., Middletown, N. Y.

5. The mileage of a locomotive.—Its relation to cost of shop and running repairs.—Does it pay to overhaul an engine that will give but 90 days' flue or firebox service?—How could this be handled?—Who should determine when to shop an engine and who should furnish the work report?

E. C. Hause, S. A. L., Savannah, Ga.
G. E. Bronson, C., R. I. & P., Colorado Springs, Col.
Geo. Moore, Intercolonial, Moncton, N. B.
E. C. Marsh, N. & W., Portsmouth, Ohio.
Chas. Paskesen, E. P. & N. E., Alamogordo, N. Mex.

6. Why do stay bolts break more frequently on the left side?

A. Bradford, Big Four, Urbana, Ill.
H. S. Briskley, E. P. & S. W., Alamogordo, N. Mex.
B. Buzzell, M. P., Poplar Bluffs, Mo.
W. H. Claugh, Erie, Hammond, Ind.

7. The quick dispatching of engines at terminals and how to handle most economically.

D. E. Barton, Santa Fe, Topeka.
G. W. Keller, N. & W., Portsmouth, Ohio.
F. W. R. Mark, B. & O., Cleveland, Ohio.
William Moore, Erie, Carbondale, Penna.
E. G. Brooks, M. & O., Jackson, Tenn.

C. H. VOGES,
Chairman, Executive Committee, G. F. A.

8. Which is the cheaper to maintain, the piston or slide valve?

W. E. Farrell, Big Four, Columbus, Ohio.
Ben Beland, Frisco, Springfield, Ohio.
Joe Claugh, Frisco, Oklahoma City, Okla.

Railway and Locomotive Engineering

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A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXI. 136 Liberty Street, New York, March, 1908 No. 3

The Railway of the Coral Reefs.

The extension of the Florida East Coast Railway to Knights Key at the present time, is a noteworthy development of land transportation by rail. This "sea-going railway" is an enterprise due to the perseverance and pluck of Mr. Henry M. Flager, president of the Florida East Coast, and his band of associates. The road will eventually reach Key West, which is in a sense America's "Land's End." The islands, which stretch out in a sweeping curve from the southern end of Florida into the Gulf of Mexico, are like giants' stepping stones, thrown down to make a Titan's way from the mainland of the continent to the fertile island of Cuba.

These islets, or keys, as they are called, were not the work of giants. They are rather the product of innumerable tiny living organisms not, intended to be the foundations for a modern railway, they were, in fact, the homes of the coral insect. The word key, when used in the sense of a coast reef or low, sandy islet, comes from the Spanish word *cayo*, a shoal. The word, however, is Celtic in origin, and is allied to our word quay.

The whole peninsula of Florida has been built up by these small but tireless workers. According to Sterry Hunt, the period of time required for the polyps to raise the reefs which form Florida, from east to west, was about 864,000 years, and the building of the peninsula from north to south must have occupied the prodigious period of 5,400,000 years. Agassiz says that probably the animaculæ built their reefs up to the surface of the water, and that afterwards the waves destroyed the reefs and having reduced them to the consistency of sand, cemented them

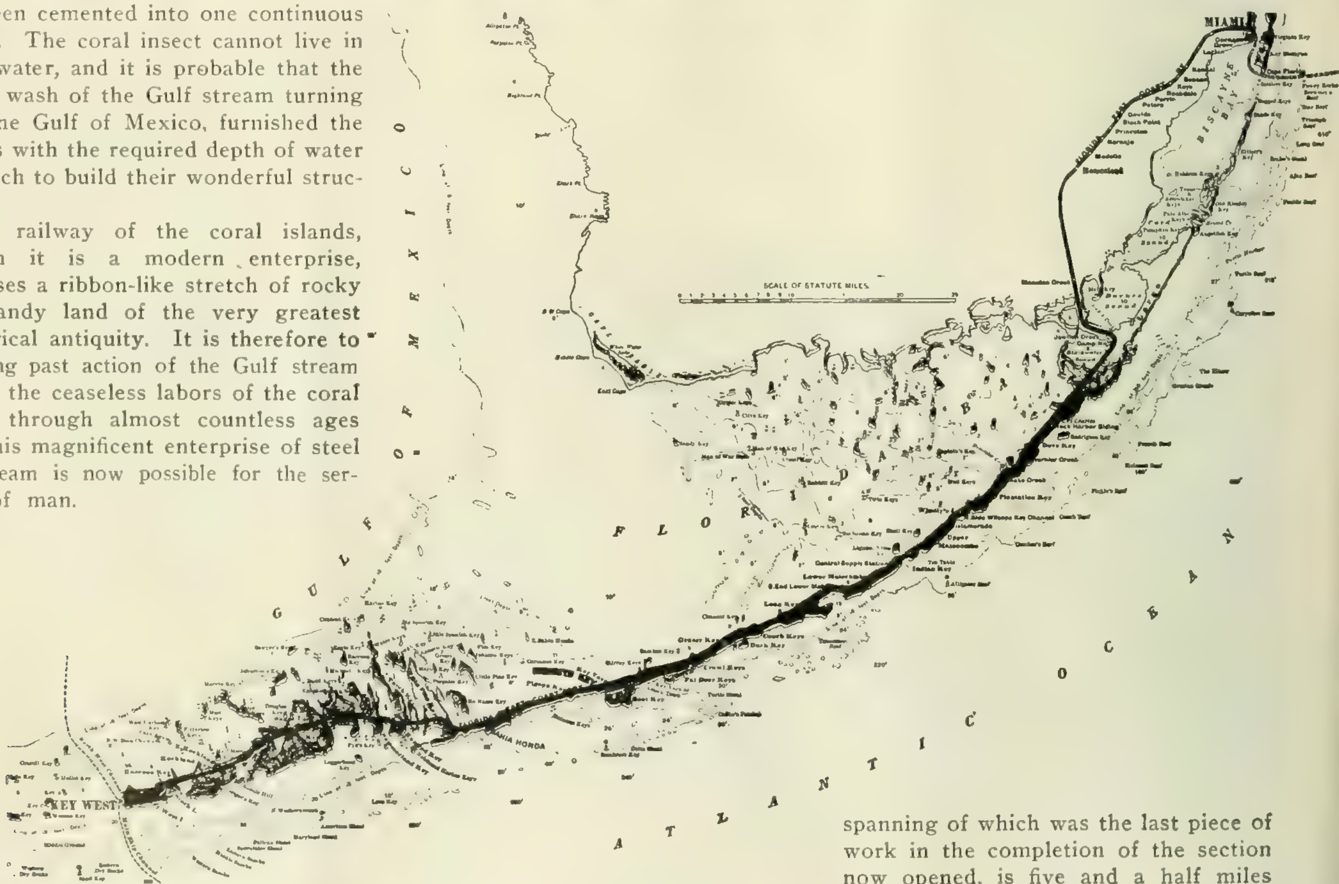
FLORIDA EAST COAST EXTENSION. OCEAN VIADUCT BETWEEN LONG AND GRASSY KEYS.

into one solid mass in combination with all the débris which is constantly cast up by the sea. The coral islands, known as the Florida Keys, are disjointed masses or reefs which have not

TYPICAL SHORE LINE OF THE WAVE WASHED AND WIND SWEPT FLORIDA KEYS.

yet been cemented into one continuous whole. The coral insect cannot live in deep water, and it is probable that the sandy wash of the Gulf stream turning into the Gulf of Mexico, furnished the polyps with the required depth of water in which to build their wonderful structures.

The railway of the coral islands, though it is a modern enterprise, traverses a ribbon-like stretch of rocky and sandy land of the very greatest geological antiquity. It is therefore to the long past action of the Gulf stream and to the ceaseless labors of the coral insect through almost countless ages that this magnificent enterprise of steel and steam is now possible for the service of man.



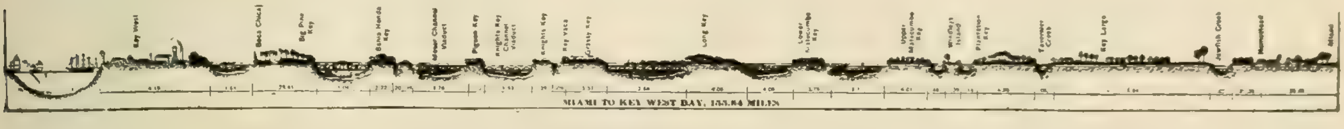
The construction of this line is map-changing work, as well as a unique piece of railroad building. When the trains began running to Knights Key, Cuba was brought, in point of time, half a day nearer the United States and Havana was for the first time placed in direct rail connection with New York and Chicago. The traveler can now take a Pullman train in either of these cities, whirl across several degrees of latitude direct to Knights Key and there step from the train aboard a boat which will land him in the Cuban capital, 115 miles distant, within six hours. In another year, when the remaining 47 miles to Key West have been opened, the distance between the United States and Cuba will be still further reduced. Key West is but 90 miles from Havana, and it is planned to join the two by a ferry service which shall take the trains themselves through, thus making the journey an all-rail one.

The condition which confronted the builders of the extension was this: From the southern mainland of Florida in a long curving line to the southwestward, lay the coral islets called the Florida Keys. These little islands stretch out into the Gulf to Key West, the last of the chain. Eastward lies the Atlantic, westward the Bay of Florida. Beginning at Homestead on the mainland, 28 miles south of Miami, where the Florida East Coast Railway ended, the contractors built along the line of these keys and across the scores of channels and passages which separate one from another. They made a road so solidly based as to withstand the dreaded autumn hurricanes which have their breeding place among the West India islands. Some of the channels are a few feet wide, some thousands of feet and some miles. The widest of all, the spanning of which was the last piece of work in the completion of the section now opened, is five and a half miles across from island to island. Everything except the rock for the roadbed and embankments had to be transported from the mainland, as the keys are mostly barren and could furnish no

supplies. Even water had to be brought in tanks and the workmen had to be housed in floating dormitories. In spite of these difficulties and of the obstacles

MR. FLAGLER AND PARTY AT KNIGHTS KEY.
(1) J. P. Parrott, Vice-President. (2) J. C. Meredith, Ch. Eng. of Constr'n. (3) Senator J. P. Taliaferro. (4) Henry M. Flagler, Prest. Florida East Coast Railway. (5) Gen. J. R. Brooke, U. S. A.

of mud and water, stiff currents, jungle, rock, heat, mosquitoes and storms, the work, once begun, has been pushed steadily on without a halt. From Homestead, where the extension be-



CROSS SECTION OF THE FLORIDA EAST COAST EXTENSION OVER THE CORAL ROCKS.

gins, it is 17 miles to the coast at Water's Edge. This part of the road is on the mainland, but it is through the strange South Floridian region of low everglades and mangrove swamps, interspersed with higher patches of rocky pine land. From Waters Edge the road crosses Jewfish creek, uniting Barnes and Blackwater sounds by a drawbridge, and after crossing Lake Surprise, where thousands of tons of rock filling were swallowed up in carrying the road across the lake, it reaches the middle of Key Largo, the largest of the keys. Fifteen miles more bring the southern end of Largo in sight and here the road becomes really amphibious. Of the forty-nine miles remaining to Knights Key more than half are built on cement and coral rock embankments or on concrete viaducts supported on concrete piers anchored to the rock bottom and strengthened with piles. At the deeper channels there are drawbridges to admit the passage of vessels and in the embankments which cross the shallower passages are 25-foot water openings at frequent intervals.

From Key Largo the extension crosses Tavernier creek to Plantation Key, which it traverses, thence over another narrow arm called Snake creek to Windlys Island, then across a wider passage to Upper Metacumbe Key. The longest viaduct yet reached carries the road from Upper Metacumbe to Lower Metacumbe, whence a still longer embankment takes it over the wide channel to Long Key, the next stepping stone. Then from Long Key to Grassy Key comes the longest leap of the whole way. Between these two there is five and a half miles of sea, which is crossed by the famous "ocean viaduct," over which the rails are carried thirty-one feet above high tide level. From Grassy Key a number of small islets and intervening passages are crossed to the larger Key Vacca, from which, over a narrow channel, over Hog Key, and across another channel Knights Key is reached, where the journey by rail is ended for the present.

The aggregate length of the construction over water between Water's Edge, where the road leaves the mainland, and the temporary terminal at Knights Key is 72,884 ft., or in round numbers, 14 miles. The first water opening of any length crossed by the traveler is over Snake Creek in Plantation Key, which is 725 ft, across. Then from Windlys Island to Upper Metacumbe Key comes a fill of 2,450 ft. The next gap from Upper Matecumbe to Lower Matecumbe is crossed by an embankment 11,950 ft., from end to end, with a 120-foot drawbridge to allow the passage of vessels. A still wider passage intervenes between Lower Matecumbe and Long Key, which are joined by an embankment of 21,800 ft. Then comes the stretch of open water between Long and Grassy Keys, 5.6 miles across, which the road spans by the great ocean viaduct, 10,444 ft. in length, with embankments at each end which together add 19,100 ft. more. From Grassy Key over the Crawl Keys to Key Vacca are other embankments of 4,875 ft. in aggregate length, one of which, 500 ft. long, crosses a channel 20 ft. deep, and from Key Vacca to Knights Key is a 1,100-foot embankment. A trestle 2,000 ft. long leads from Knights Key to the Knights Key dock, to which a deep channel leads, permitting vessels of 20 ft. draft to come alongside the wharf.

The 47 miles of unfinished work from Knights Key to Key West will add 78,550 ft. more of embankment and viaduct, making the total for the entire extension 155,000 ft., or 29.4 miles. To this should be added the 17 miles from Homestead to Waters Edge, through the Everglades, which is practically a continuous embankment, dredges having been used in the construction work for the entire distance.

The most important openings in the uncompleted portion are between

THE COCOANUT PALMS OF THE KEYS.

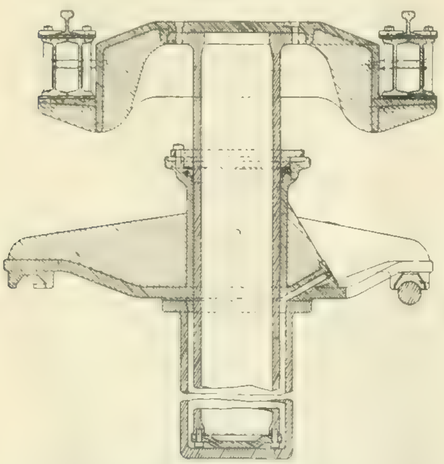
Knights Key and Pigeon Key, where there is an opening of 10,250 ft., of which 7,300 ft. is to be crossed on a viaduct; between Pigeon and Little Duck Keys, where there is a 22,900-foot gap of which 7,800 is to be viaduct,

and from Bahia Honda Key to West Cumberland Key, 5,600 ft., of which 4,950 ft. is to be viaduct, with a 250-foot draw for vessels.

In all there are 42 of the famous Florida keys on the route from Largo to Key West, some large, some but a few hundred feet in length, but all alike in their general characteristics. On the west side of each is a border of red mangrove swamp and on the Atlantic side is a coral beach fringed with palms. In the interior of the larger islets a luxuriant tropical vegetation flourishes and the road, which follows the highest elevation, passes through hummock in which grow mahogany trees, cocoanut palms, gigantic orchids and the cactus, the lime, the banana, the pineapple and many other trees and plants which are strange and new to the traveler from the temperate zone but which are the natural surroundings of this railway of the coral reefs.

Southern Pacific Drop Pit.

At the last meeting of the General Foremen's Association Mr. E. F. Fay, the president, when speaking of a trip he had made over the Southern Pacific, referred to the shop at Spark's, Nev. He believed it was an almost ideal roundhouse, and at another point on the same line he said "they have the finest dropjack or, more properly termed, drop table, in the country." The drop jack, or table, or pit, referred to is situated at San Francisco and at nine other locomotive stations they have the same design of table in use.

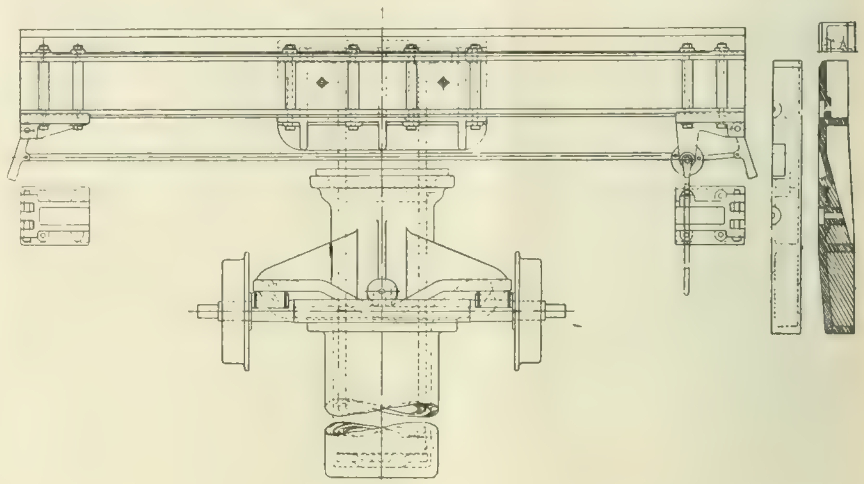


HYDRAULIC JACK, END VIEW OF DROP TABLE, AND SIDE VIEW OF TRUCK PLATE.

We are able to give some details of this excellent shop appliance, through the courtesy of Mr. H. J. Small, general superintendent of motive power.

In the first place, the drop pit itself is a concrete depression in the shop floor which is 10 ft. 8½ ins, wide, and takes in three of the ordinary round house pits. The walls of the drop pit are 18 ins. thick and the depth of the pit is 8 ft. 7 ins. On the floor of this pit there is a track, 4 ft. gauge, laid with 62-lb rails and curved to the radius of the rouud house itself so that the car which runs on this track is at right angles to each of the shop pit rails when it is in position under any one of them.

This car, or drop table truck, as it may be called, resembles an engine truck insofar that it is a four-wheeled vehicle with a strong, heavy webbed steel casting or carries a heavy webbed steel casting which supports the drop table. The drop table casting is 3 ft. long and each side carries a pair of I-beams 10 ins. deep placed side by side, capped and based by ½-in. cover plates. On the top of the upper cover plates are the locomotive track rails, 75 lbs. to the yard. The four I-beams, two on a side, are bound together by the table centre casting and by a 4-in. tie plate at each end. Thus a section of track of standard gauge 10 ft. 5½ in. long can be lowered or raised through 62 ins. as required, and made to form part of the shop track in any one of three round house pits.



SIDE VIEW OF DROP TABLE, END VIEW OF TRUCK, AND LOCKING ARRANGEMENT.

truck-plate uniting the whole, and having, as one might say, an exceedingly large centre bearing, which in reality is the upper part of the hydraulic jack which does the lifting and lowering. The truck wheels are 18 ins. in diameter and the spread of the wheels is 60 ins. The axles of this truck have extension ends which terminate in squares upon which a ratchet lever can be slipped, in order to move the truck back and forth as desired. The truck is made with inside bearings like an engine truck, and the ratchet levers go on outside the wheels.

The drop table truck has, as we have said, a large centre casting made in one piece with the ribbed truck plate. This centre piece is a cylinder 15 ins. in diameter and 24 ins. deep. On the under side of this cylinder an extension is bolted. The extension is 71 ins. deep, thus making the outside length of the whole vertical cylinder 95 ins. This forms the barrel for the hydraulic jack. The plunger is hollow and is 15 ins. in diameter and fits closely into the 24-in. top of the barrel which belongs to the truck plate. This close fit of plunger and barrel acts as a guide for the plunger as it goes up and down. Below this, and in the 71-in. well or bottom of the jack, the barrel has a diameter of 17 ins. This jack, which might with more propriety be called a traveling hydraulic lift, has a stroke of 62 ins. ordinarily. The total lift, however, required for releasing the detents and other adjustment is 64½ ins.

The plunger of the hydraulic lift is like a circular pillar, the capital of which

When the drop table is up in place, so that the rails form part of the shop pit track, they are locked in position in a very simple but effective manner. The ends of the double I-beams forming the drop table, are, as we said, united by cover plates top and bottom. On the under side of the lower plates four lock castings are bolted, from each of which hangs a locking bolt. This bolt is not shot in and out, in the usual manner. It is swung into position in a notched wall plate, when the table is to be held up. The locking bolts, for there are four of them, thus form small short pillars inclined at a slight angle, but the angle is sufficient when the weight comes on the locking bolts, to cause them to engage closely with the notches in the wall castings and the heavier the weight on the table, the tighter the locking bolts cling in their supporting position. The notches in the wall castings, into which the locking bolts are swung, are such that entrance only can be made when the rails on the drop table are in line, and forming part of the shop pit track. The drop table is thus like a four legged stool wedged into the wall and practically forming a bridge over the drop pit. To release the locking bolts, the plunger raises the table slightly, and a lever attached to a disc with rods, when moved, swings the locking bolts out of the wall notches and the

table can be lowered. When down in its lowest position the plunger bottoms on the lower end of the barrel and the table and its load is thus carried directly on the truck without any support from the liquid confined in the barrel. When up in place and locked, the table and load are carried on the short pillar-like locking bolts, fitting into their wall notches and the liquid in the jack does not necessarily support weight. In fact, the liquid in the jack or hydraulic lift, is employed to produce the motion of the plunger and is used when the table is in the act of going up, or down. The weight when at rest, may be carried directly, either on the truck or on the supporting wall castings. In this way the chances of a slip, due to leakage, are avoided.

The floor of the drop pit contains a deep groove, if we may so call it, in which the lower part of the hydraulic jack barrel moves as the truck is traversed from one shop pit to another. The barrel is fitted with a ¾-in. connection for rubber hose, so that water may be supplied to, or released from, the jack, no matter under what track the carrying truck may be. Suitable valves control the inflow and the release of water. The plunger having a diameter of 15 ins. has a circular base of 176.71 sq. ins. and water at a pressure of from 150 to 200 lbs. per sq. in. would support a weight in round numbers of from about 13 to 17 tons.

This useful shop device is in every way a justification of the remarks made by Mr. Fay, which we quoted at the beginning of this article, for the design of this drop table and the details which have been worked out show that the whole subject has been carefully studied and that safety, strength, and durability have been what musicians would call the leading "motif" of the whole composition.

Missouri & North Arkansas 2-8-0.

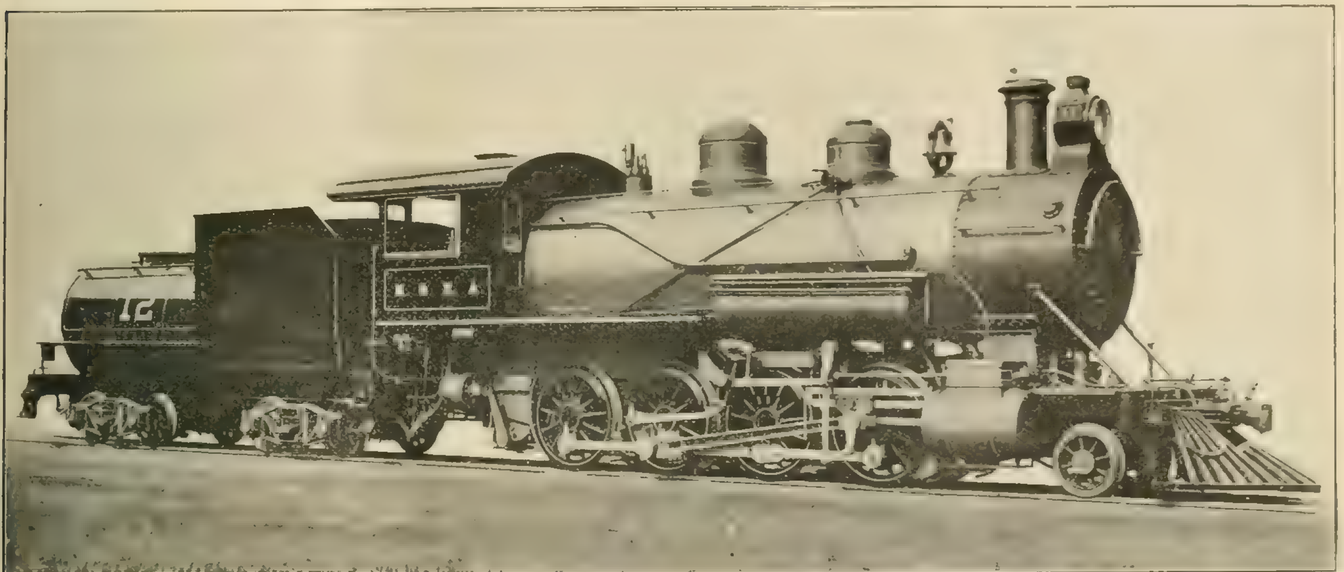
The Baldwin Locomotive Works have recently delivered to the Missouri and North Arkansas Railroad five simple consolidation or 2-8-0 type of locomotives for freight service. The road is laid with 65 lb. rails, the maximum grades are 1¾ per cent. and the curves are of 12 degs. radius. The new locomotives can exert a tractive force of 37,000 lbs. The cylinders are 22 x 28 ins. and the driving wheels are 56 ins. in diameter. With the tractive effort as stated and a weight of 167,000 lbs. carried by the drivers, the factor of adhesion becomes 4.5.

While there are few unusual features in this design, this engine represents a type which has been giving excellent satisfaction in heavy freight service. The average load per driving-wheel is very nearly 21,000 lbs., which is practically the limit per wheel that can be safely carried on a 65-lb. rail. The valve gear, as may be seen from our illustration, is the Walschaerts gear and the main valves are of the Richardson balanced type, with vacuum valves. The main valves are driven through rocker shafts whose bearings are bolted to the guide yoke. With this arrangement the valve rods are comparatively long and it is unnecessary to use knuckle joints or crossheads to prevent them from springing. The combining levers are placed back of the crossheads, instead of in front of them as has been usual in some previous designs. The link bearings are bolted to a crosstie which spans the frames between the second and third pairs of driving-wheels. Each bearing is made in one piece and the links are of the built-up type with double trunions. The reverse shaft bearings are mounted on braces, which connect the previously mentioned crosstie with the guide yoke. With this arrangement only one reverse shaft is necessary, and the link blocks are down when in forward gear. This is an advantage, as the slipping of the blocks is reduced to a minimum.

Among the large cast steel details used in these engines may be mentioned the frames, mud rings, cross heads, driving boxes and driving-wheel centers. The latter are fitted with brass hub liners. The two leading pairs of driving wheels are equalized with the engine truck, which is equipped with a swing bolster hung on three point suspension links. The main and rear pair of driving wheels are equalized through beams placed over the boxes. The frames have double front rails and the pedestal binders are lugged and bolted to the pedestals. All the wheels are flanged and the spacing of them is as nearly as possible equal. The driving wheel base is thus 15 ft. 4 ins., while the wheel base of the engine is 23 ft. 8 ins. The engine truck carries a weight of about 14,900 lbs. and this, when added to the adhesive weight given above, makes the total weight of the engine 182,200 lbs.

The boiler is of the straight top type, 72 ins. in diameter at the smoke-box end. The firebox has a vertical throat and back head. The roof sheet is slightly inclined toward the rear. A narrow firebox is used in this design, but the side water legs are free from abrupt changes in direction, thus helping to promote circulation and favoring the distribution of the staybolts. A cast steel furnace bearer, sliding on a substantial crosstie of the same material, supports the firebox at the front end.

The heating surface is 2,791½ sq. ft.,



J. P. Dolan, Master Mechanic. MISSOURI & NORTH ARKANSAS RAILROAD 2-8-0 SIMPLE ENGINE. Baldwin Loco. Works, Builders.

made up of 194.9 in the firebox itself and 2,596.6 sq. ft. in the tubes. There are 344 tubes 2 ins. outside diameter and each 14 ft. 6 ins. long. The grate area is 34.9 sq. ft. and thus the heating surface is very nearly 80 times that of the grate area.

The tender is of the Vanderbilt type, with cylindrical water tank. The frame is built of 6 x 4 in. steel angles. The trucks are of arch bar design, with steel bolsters and triple elliptic springs. The front wheels in each truck are steel tired with spoke centers, while the rear wheels are of chilled cast iron. The capacity of the tank is 6,000 U. S. gallons and 14 tons of coal may be carried. The wheels used are ordinary 33-in. cast iron and the journals are 5½ x 10 ins. The total wheel base of engine and tender is 58 ft. 8 ins. and the total weight with tender counted in is about 300,000 lbs.

Mr. John P. Dolan, the master mechanic of the road, through whose courtesy we have obtained much of the information given here, says in referring to this batch of freighters: "We have these engines in service now and they are giving excellent results. They are good steamers and are good steady runners on both tangents and curves. The Walschaerts valve gear is popular with the engineers, the machinists and the management. We use the Westinghouse E. T. equipment, which, besides giving good service in switching, enables the engineers to prevent excessive heating of tires on mountain grades. We are much pleased with the Vanderbilt cylindrical type of tender for its steadiness in running and easy access for inspection." The engines are of the Baldwin standard type, with some changes and specialties to conform with conditions of service as decided upon by Mr. Geo. L. Sands, vice-president of the road, and by Mr. J. P. Dolan, the master mechanic.

A few of the leading dimensions, etc., are here appended for reference:

Boiler—Material, steel; thickness of sheets, ¾ in.; working pressure, 180 lbs.; fuel, soft coal, staying, radial.

Fire Box—Material, steel; length, 121 ins.; width, 41⅝ ins.; depth, front, 71½ ins.; depth, back, 69 ins.; thickness of sheets, sides, 5-16 in.; thickness of sheets, back, 5-16 in.; thickness of sheets, crown, ⅜ in.; thickness of sheets, tube, ½ in.

Water Space—Front, 4 ins.; sides, 3½ ins.; back, 3½ ins.

Tubes—Material, iron; Wire gauge, No. 11.

Driving Wheels—Journals, 9x13 ins.

Engine Truck Wheels—Diameter, 30 ins.; journals, 5½x12 ins.

Nathan triple bulls-eye automatic sight-feed lubricator.

Motor car service has been inaugurated on the Union Pacific between Grand Island, Neb., and Ord. This takes the place of a passenger train which has been operated between these points for about 20 years. This is the fourth district of the U. P. in Nebraska on which motor cars are in regular service.

Among the Railroad Men.

By James Kennedy

AT COLLINWOOD.

Collinwood is a beautiful suburb of Cleveland, Ohio, and the central shops of the Lake Shore and Michigan Southern Railroad are situated there in a fine location. The shops are elegantly constructed and are divided into squares resembling a miniature city. There is a vastness about the interior and a newness about everything that gives one the impression that a great mechanical exhibition is expected to do. There is something spectacular about the splendid locomotives that come out of the great works, and while they do not have the gaudy glitter of the burnished curiosities of forty years ago, their very sombreness of color seems to add to their perfect symmetry and is becoming to their great strength.

The Walschaerts valve gear is extensively used on their fast passenger as well as on the freight engines. The officials express themselves as well pleased with the efficiency of the engines in service, the comparatively small cost of repairs to valve gear parts between the periods of general repairing being a marked feature since the introduction of the new gearing.

C. P. R. FLYER HAULED BY A VAUCLAIN COMPOUND.

In the shops there were evidences everywhere of the highest engineering skill, especially in the moving and conveying of heavy material. The ordinary traveling cranes were relieved by an extended system of jib cranes serving a wide circle of machines. This feature is being constantly added to and facilitates the work of the heavier machines very much. It could be readily noted that the antiquated methods of carrying material into lofty galleries or distant buildings was entirely avoided. The arrangements of cab and truck repairs, brake and spring rigging were all made on the erecting floors, four pits being set apart for these purposes. An interesting feature was the method of moulding brasses into the driving boxes, thereby avoiding any fitting. Five separate dovetailed grooves are cut in the inner arch of the casting. The boxes are slightly heated. A mandrel of the size desired is adjusted to the box and the mould is completed. The molten brass or bronze is poured in and the contraction incident to cooling tightens the metal in the dovetailed recesses. The bearing is very secure, no instance of loosening being recorded, while a slight taper to the recesses renders the operation of removing the brasses from the boxes an easy one under hydraulic pressure.

The system of specialization in groups of skilled workmen confined to distinct branches of work seems to be productive of the most gratifying results. The stripping gang pass from engine to engine, followed in unbroken succession by the experts on pedestal jaws and binders and wedges. Simultaneously others are at work on the cylinders and valve seats. Flues are in the hands of another skilled group. The boiler mountings are being renewed by another skilled section, and so on with such little loss of time that in an average of ten or eleven days the locomotive is out again. The process of steaming up in the shop is cleverly accomplished without smoke, an adjustable hood covering the smoke stack and carrying the smoke away by the action of a strong fan. While the locomotive is still under a pressure of steam the traveling crane lifts the engine and removes it to the tracks.

The machines generally are of the latest designs, the largest being a 90-in. lathe furnished by the Niles,-Bement-Pond Co., with a 50 horse power electric motor drive. The work performed by this powerful machine is excellent, while the output is about ten pairs of wheels per day of nine hours. Among the drill presses a large number of flat drills were in use, but the velocity seemed to be unusually high, the drills being made of high speed steel. A special grinding department kept a constant supply of drills of all sizes ready so that the drill press men did not require to wander around like the ten lost tribes of Israel.

A new feature was shown in the excellently classified arrangement of blue prints in charge of an accomplished draftsman who, in addition to furnishing the drawing of any part of any locomotive at once, also cleverly sketched broken parts for the information of the departments. This is a marked improvement on the ramshackle method generally in vogue of having overworked gang foremen searching for drawings like Oriental scholars rummaging among the ruins of Nineveh.

The machine shop men and methods, clever as they were, are but "as moonlight unto sunlight, and as water unto wine," compared to the blacksmith

shop. Dies so perfect that the product looks like fine castings are at work all over the vast shop, and new designs are in course of construction that look strangely out of place in a blacksmith's shop, but the wonders already accomplished give ample promise of new miracles to be performed. Some were small and intricate, others heavy and powerful. Some ponderous machines were occupied in making spring bands, large clasps that hold the leaves of the springs in place. The entire operation of cutting and bending and welding the band was performed by one machine in an incredibly short space of time. Nuts with lateral slots for engaging spanner wrenches were struck into perfect shape at one blow, and the smaller forgings generally could not be surpassed either in perfection of form or rapidity of construction, the designs of the forging machines being largely the product of the shop organization.

In the boiler shop the flue department was perhaps the most interesting as showing a systematic manipulation of the flues that would be difficult to improve upon. In service the flues are removed after the standard run of 50,000 miles are completed. Their removal, cleaning, welding and setting anew in the boiler cost eight cents per flue, and although there are no piece workers in the boiler shop a standard day's work is maintained that is eminently satisfactory to all concerned. The novel flue plant is handled by five men, one man heating, scarfing and safe ending, the other welding and swedging. Both men use the same furnace, the flue not being allowed to cool from start to finish. In this way the output averaged one flue per minute or nearly 600 per day. The drawings or templets in the boiler shop are of the best, and it may be noted that in the case of new fire boxes or flue sheets there is no such thing as trying the work on the job and marking holes from the old on to the new work, the new part is laid out correctly from the original design and put in place and rivetted up without delay. The rivetting and flue expanding and drilling and tapping are all done by compressed air machine. In the twenty main pits in the machine shop there is every kind of appliance calculated to facilitate work, the output of engines completely repaired amount to about 50 per month, not speaking of special and running repairs which are constantly going on in another section of the shops as well as in the round house.

The car department kept pace with the machine shops and a large number of caboose and baggage cars were being completed which will add greatly to the new equipment. In special work the most important feature was a magnificent new dining car, one of the finest ever built and the second of its kind erected at the Collinwood works. It was elegant in design and gorgeous in adornment and altogether a palace on wheels.

Several notable features could be seen in the great shop yards, one being a second hand material department where all worn parts were collected and such as could be used were sent to the various departments for repair and much material is thereby saved that would otherwise be discarded. One man managed this important branch. The yard crane was an object of curiosity. It reached all over the great yard and every kind of material was under its spreading wings and it certainly is giving ideal service.

It may be noted in closing that while the great bulk of the work is being done under the contract or piece work system there is an underlying wages rate below which no mechanic is asked to work. The excess over this rate is in almost every case very liberal and evidently very satisfactory to all concerned. The number of skilled workmen owning their own homes is remarkable, and the elegance and beauty of these suburban residences have to be seen to be appreciated. Under such conditions and in such environment the daily drudgery of mechanical toil becomes light and agreeable, and the shops of Collinwood might very properly furnish an example to the entire country of how physical comfort can be retained under conditions necessitating the most difficult and multiplex engineering operations.

The best way to get along with a competitor is to treat him well. If you abuse him unjustly you get the name of being envious and do yourself harm. Pry into your own business instead of his, and you will be better respected and more prosperous.—*Cincinnati Enquirer.*

Jim Skeevers as Traveling Engineer.

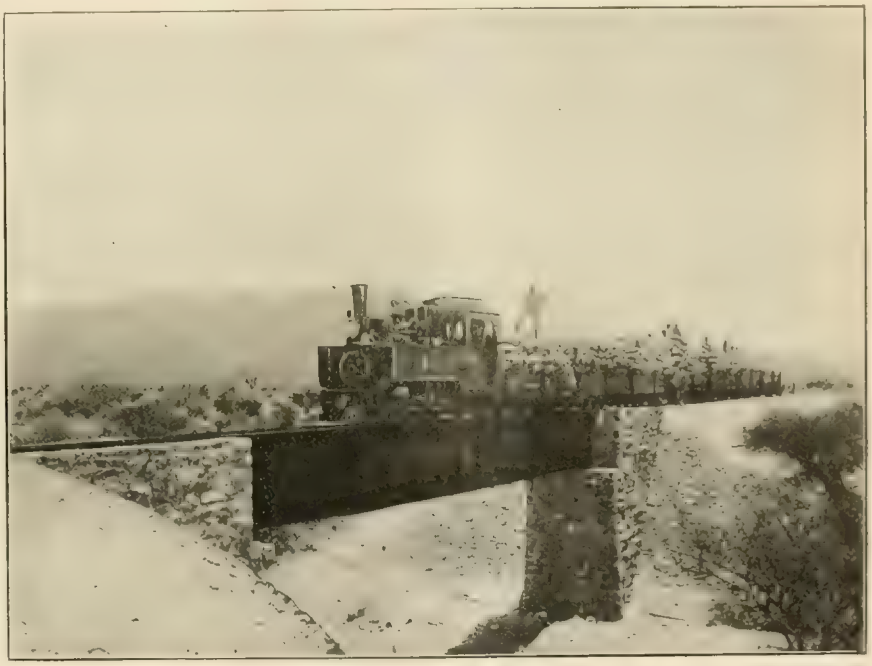
By John A. Hill

The regular man took a ninety days' leave a while ago to go East, and Jim Skeevers was appointed traveling engineer, *pro tem.*

Skeevers' principal duty seemed to be examining firemen for promotion and going out to buck snow.

They have a new general superintendent and he is a terror on examinations. He ordered all the engineers, old and young, examined on time card, and if one of them wavered he sent him to the master mechanic for a mechanical examination.

Finally he turned this around and ordered Skeevers to examine all the engineers, and if any of them wavered in the mechanical line to send 'em to him



MILITARY TRAIN ON THE OTAVI RAILWAY.

The day after the order came out the Stove Committee were discussing it, when Skeevers came through the roundhouse.

"Skinny Skeevers fired for me ten years ago," said Si Lapan, "and I don't guess he'll monkey examining me much.' Here he saw Skeevers and continued:

"Say, Skinny, do you intend givin' us old timers the same question to answer as you do these young ducks?"

"Yes. What's the use of doing a thing 'less you do it right? If you know the answers better than the young fellows, so much the better for you."

"It's all poppy-cock; ain't I run here twenty years?"

"Yes, but the new management have made many changes and are going to adopt a new book of rules; trains are getting thicker; we have some signals; we're using joint track, and, all in all, a fellow has to be pretty well posted to

keep out of trouble. The fault with you old fellows is that you don't keep posted —you learned how once, but never kept track of improvements.'

"I'll bet you I kin answer more questions than you can, come now."

"Oh, I'm not setting myself up for an example. You will pass on your merits, no doubt. Now, there has been two dozen young fellows examined, and the same question is asked 'em all first. You don't keep track of the run of things, and I'll bet you can't answer it now."

"Bet you the cigars."

"All right; for the crowd, Si."

"For the crowd."

"Well, Si. What is a time card?"

"Oh, Lordy! What's a time card? Why, well, a time card is a—well, it's a thing to run trains by."

"No, it isn't."

"Well, it's the thing that tells the first-class and second-class trains apart, and which has the right of the road, and where to meet, and where to stop, and when."

"Not much; you're thinking of the book of rules; we're talking about time card only."

"Well, it governs the running of trains."

"Say, Si, if you were out here at Dodd's on 'No. 1' and '22' wasn't there, what would you do?"

"Go ahead; 'No. 1' has the right."

"Suppose you were on '22'?"

"Well, if I couldn't get there, I'd lay back at Somers."

"Yes, but the time card makes you meet 'No. 1' at Dodd's."

"But if you couldn't get there——"

"Then how does it govern the running of trains? The book of rules does that. Si, you don't know. Well, I'll tell you, as this is no regular examination. A time card is a list of the stations and the time at which *it is proposed* to have the trains arrive at or leave such stations.'

"I smoke perfectos, don't you, boys?"

H.-P. Required for Shop Tools.

A most instructive and exhaustive treatment of the subject of the "Power Requirements of Railroad Shop Tools" from the pen of Mr. L. R. Pomeroy, recently appeared in the *General Electric Review.* Space does not permit us to reproduce the whole article, but the light thus thrown on this important subject makes a few extracts quite in order.

The formula used by Mr. Pomeroy to calculate the horse-power required to drive various shop tools when engaged in doing work will be found convenient by many master mechanics and general foremen or others interested in the subject. The formula as given is

$$HP = F \times D \times \text{f.p.m.} \times 12 \times N \times C$$

Where F is the feed in inches D is depth of cut in inches, f.p.m. is feet per minute, N is the number of cutting tools used, C a constant of the following values:

Cast iron	0.35 to 0.5
Soft steel or wrought iron	0.45 to 0.7
Loco. driving wheel tires	0.70 to 1.0
Very hard steel (crucible)	1.00 to 1.1

A number of examples of the use of the formula just quoted are given and we select three as typical illustrations. First, a steel tired wheel lathe turning engine truck wheels with a feed of 1/7 of an inch, a depth of cut of 5/16 in. The cut taken at the rate of 16 ft. per minute, two cutting tools at work, and the value of constant C taken as 1 for the material turned off. The equation to satisfy these values becomes

$$H\ P = 1/7 \times 5/16 \times 16 \times 12 \times 2 \times C$$

This gives a horse-power of 17.

Another example is that of a planer working on a wrought iron engine frame, with two tools having 5/32 in. feed, ½ in. cut, 16 ft. per minute, with

U. P. NEW BRIDGE AT FORT STEELE, WYO.

a value for C of 0.5. The equation becomes

$$H\ P = 5/32 \times 1/2 \times 16 \times 12 \times 2 \times 0.5$$

This gives a horse-power of 15.

The third example is of an 84-in. boring mill, working on 62-in. cast iron driving wheel center with three cutting tools at work, a feed of ⅛ of an inch, a cut of 1/10 of an inch taken at the rate of 30 ft. per minute with a value for C of 0.35, the lowest value given for cast iron. The substitutions for this machine make the formula stand

$$H\ P = 1/8 \times 1/10 \times 30 \times 12 \times 3 \times 0.35$$

This gives a horse-power value of 4.7.

A machine designed for axle work and capable of taking two cuts ¾ × 1/12 ins. at 24 ft. per minute would require 18 horse-power. This machine, Mr. Pomeroy says, would usually be supplied with a 20 h.p. electric motor, yet for the average requirements of railroad shop work 10 h.p. would probably be sufficient. The table of power values given below shows the motor horse-power required in each case, as given in Mr. Pomeroy's article: The figures given at the right hand side of the column in the following table represents the motor horse-power required to drive the tool specified.

POWER VALUES FOR VARIOUS MACHINES.

BOLT AND NUT MACHINERY, HELVE HAMMER, MULTIPLE DRILL, ETC.	
One and one half-inch single-head bolt cutter	1½
Pratt & Whitney No. 4 turret bolt cutter	2
Two-spindle stay bolt cutter	2
One and one half-in. Acme double-head bolt cutter	2½
One and one half to two and one half Acme nut facer	2½
Six spindle nut tapper	3
One and one half-in. triple-head bolt cutter	3
Three-fourths to two and a half-in. double-head bout cutter	3
Two-in. triple-head bolt cutter	5
Four-spindle stay bolt cutter	5
Bradley hammer	7½
Niles four-spindle multiple drill	7½
GRINDERS.	
Air-cock grinder	1
No. 3 Brown & Sharpe universal grinder	3
Link grinder	3
Sellers universal grinder for tools	5
Norton 18x96-in. piston rod grinder	5
MILLERS.	
Vertical miller Becker-Brainard No. 2	1
Valve miller No. 2	2
Universal miller No. 3 Brown & Sharpe	2
Universal miller No. 4 Brown & Sharpe	5
Universal No. 6 Becker-Brainard	5
Niles heavy vertical	10
PUNCHES AND SHEARS.	
No. 4 36-in. throat L. & A. punch	3
No. 9 horizontal flange punch	5
No. 2 Hillis & Jones combination punch and shear	5
Alligator shear (stock 5x1 in.)	5
Lenox rotary bevel shear	7½
Thirty-six-in. multiple tank plate punch with spacing table	7½
No. 3 Hillis & Jones combination punch and shear, 12-in. throat	7½
No. 2 horizontal punch 20-in. throat	7½
No. 3 Hillis & Jones combination punch and shear, 36-in. throat	10
No. 3 angle shear 5x1-in. bar	10
SAWS.	
Band saw, 36-inch wheel	3
Band saw, 42-inch wheel	5
Swing cut-off saw	5
Band saw, 48-inch wheel	7½
Greenlee No. 1½ self-feed rip saw	10
Greenlee vertical automatic cut-off saw	15
Forty to forty six-inch saws	15
Automatic band resaw	20
Greenlee No. 6 automatic cut-off saw	20
Greenlee No. 3 rip saw	20
Woods No. 4 rip saw	20
Extra heavy automatic rip saw	25
WOOD-WORKING TOOLS.	
Fay-Egan single-spindle vertical boring machine	3
Fay-Egan three-spindle vertical boring machine	4
Fay-Egan No. 6 vertical mortiser and borer	6
Fay-Egan No. 7 tenoner or gainer	7½
Fay-Egan universal wood worker	7½
Fay-Egan four-spindle vertical borer	7½
Fay-Egan five-spindle vertical borer	10
Fourteen-inch inside molder	12
Fay-Egan universal tenoner and gainer	12
Fay-Egan vertical tenoner	12
Greenlee automatic vertical tenoner	15
Fay-Egan No. 3 gainer, also Greenlee	15½
Greenlee extra-range five-spindle borer and mortiser	15
Greenlee vertical mortiser	15
Fay-Egan automatic gainer, also combination gainer and mortiser	20
Fay-Egan No 8 vertical saw and gainer	20½
Vertical hollow chisel mortiser and borer	20
Fay-Egan 14½-inch double-cylinder surfacer	20½
Heavy outside molder	20
Six-roll direct-connected planer and matcher	25
Double-cylinder fast flooring machine	30
Double-cylinder planer and matcher	30
Fay-Egan No. 8 automatic tenonen	30½
Woods No. 27 matcher	35
Four-side timber planer, heavy	60

Practice vs. Theory.

An assistant engineer of an electric power station was up for examination to pass for a second's certificate. "Tell me," said the examiner, "what steps would you take if the main steam-pipe were giving out?" The intensely practical man replied: "I would take the engine room steps three at a time." He passed—the door, outward bound.

General Correspondence

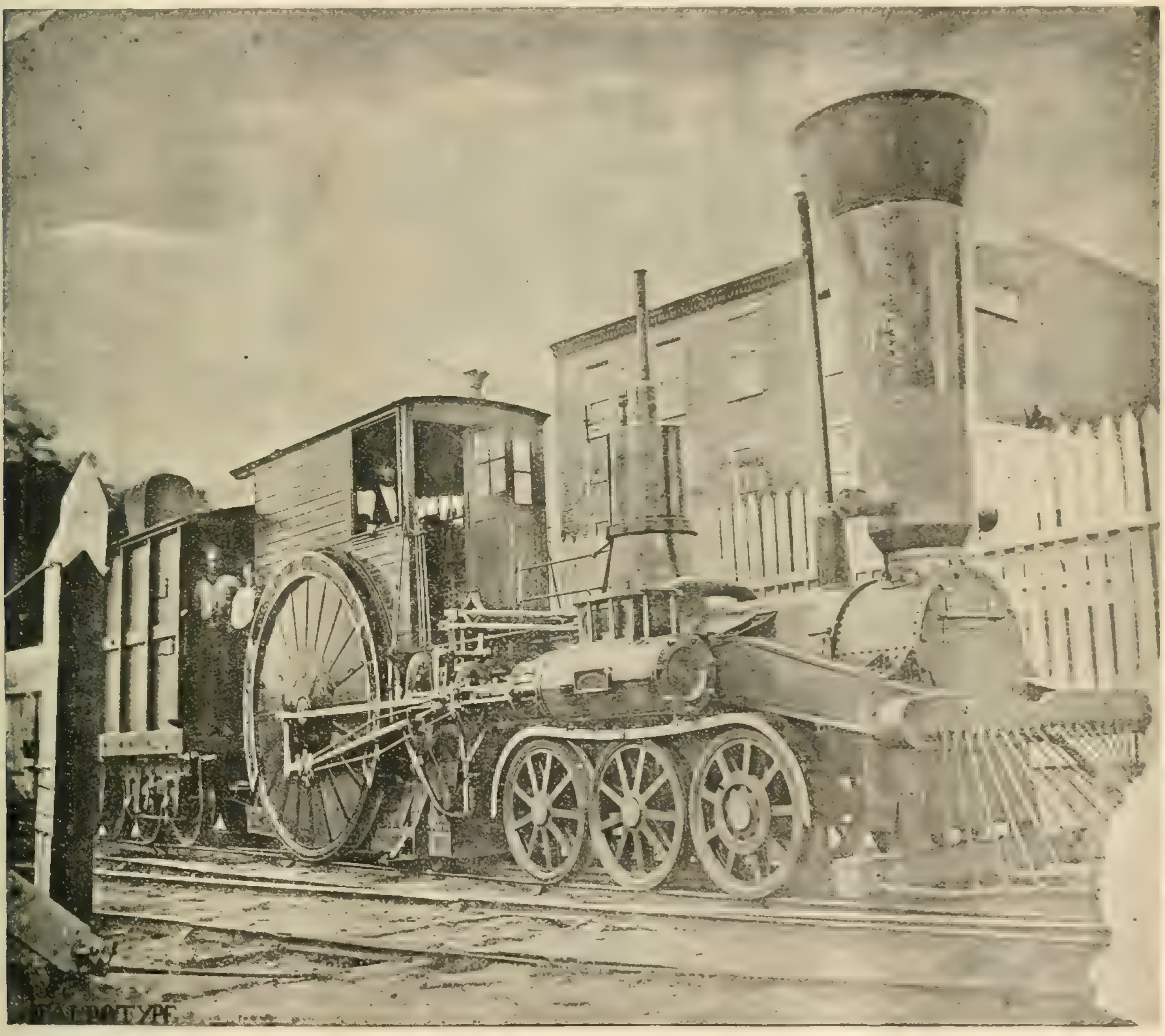
Some Designers' Don'ts.

Editor:

In the article on your new chart in the January issue, page 35, there was a statement which takes up very little room, only four lines, and probably has attracted little attention in itself, but it strikes at the very foundation of economical locomotive design. The statement is: "It is our experience that an engine which is popular with the men who have to operate it is very likely to cause little trouble otherwise. This applied especially to the cab fixtures, but it also applies from the tip of the pilot to the end of the tender coupling."

Aside from the question of proper design, in a mechanical sense, the economical engine is the engine which receives the best care from the men who come into intimate contact with it on the road and the engine which receives the best care is the one which is easiest to care for. I believe David Harum made the remark that "there is about as much human nature in some folks as there is in others—if not more," and while engineers and firemen are human, it takes more enthusiasm than most men possess to work over a bothersome adjustment, after a hard run, which "might just as well be put off till some other time." No matter how willing a man may be to keep his engine in order, a troublesome adjustment is doubly annoying when it is in a needlessly inconvenient position.

This is not a new subject, but it is highly important and does not always receive the care and thought that its importance demands. In general it is up to the Mechanical Department, but in particular it is up to the man behind the drawing pencil. You may have more or less freedom to use your own judgment in laying out the design, but as far as possible lay out your engine as though you were going to run it yourself. In other words, put yourself in the place of the engine crew. A great many questions, such as the location of different fixtures, bolts, oil holes, etc., can be settled when the assembly drawings are made up. A piece may be perfectly correct in design when considered alone, but when put in



THE "JOHN STEVENS" AS IT APPEARED IN SERVICE ON THE CAMDEN & AMBOY RAILWAY IN 1849.

place on the assembly drawing, a set-screw or bolt may be so tucked away against something else as to be practically inaccessible.

When a bolt or oil cup is situated round or between the frames, don't put it where it requires the arms of a monkey to reach it from the outside, or the neck of a giraffe to find it from under the engine. Don't fail, especially on fast express locomotives, to group gauges and levers where the engineer can see and reach them with as little change as possible from his position in the cab window. Don't put the lubricator where the fireman has to fill it through a hole in the cab roof. Don't forget that the parts of a locomotive have considerable movement, not only alone, but in relation to each other. A bolt or oil hole which is easy to reach in one position may, in another, be hidden or made inaccessible by an adjacent piece.

Don't forget that a fireman may handle several tons of coal a day and that it takes 4,000 foot-pounds, let alone muscle, to lift a ton of coal two feet. Place the fire door as low as possible. Don't expect the fireman to develop the skill of an Alpine guide or a Rocky Mountain goat when he goes out to clean the headlight. Plenty of steps and hand rails may or not be ornamental, but they are mighty convenient, especially in icy weather. Don't use a ½-in. bolt in one place, a 9/16 in. in another and a 7/16 in. in a third when a ½-in. will do for all three. It saves considerable adjusting of wrenches. Don't fail to allow plenty of room for a wrench to swing. Don't forget that a piece may get broken and have to be removed. Make it accessible. Don't forget that these are only a few don'ts out of many. In case of doubt ask the man behind the throttle. He knows a dozen to every one we could think of, because he is on the road with the engine and we are not.

SYDNEY C. CARPENTER.
Plainville, Conn.

Green Shade for Headlight.

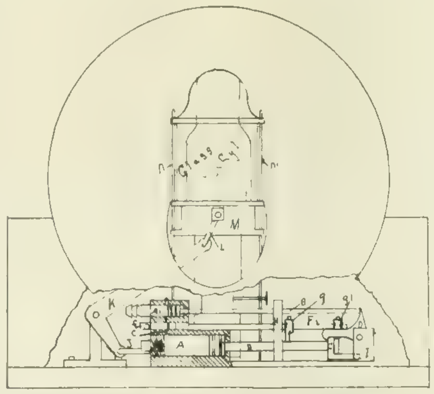
Editor:

Thinking you might be interested in a device which was built and tested at Meadville, Pa., during the early part of last year, I send you a brief description of its working and objects. The inventor and patentee is A. W. Collom, an engineer on the Meadville Division of the Erie. Mr. Collom having had a number of years' experience on single track road felt that the means of covering headlights as required on single-track were very crude and entirely ineffectual and accordingly cast about for some better means, with the result that in May, 1907, he was granted a patent on a headlight cover that was heartily approved of by both local officers and running force of the Meadville Division of the Erie after a practical test had been made which extended over several months.

The inventor contended that a headlight wholly obscured really stood for nothing, and often became a source of danger by making a siding look as if empty when occupied by train, all lights being sometimes obscured, as when no signals are carried and siding on a curve. Instead of covering the headlight with metal disk or oil cloth curtain he causes a green cylinder of glass to be placed around the chimney, thus changing the color of the light. This does not obscure the light, so the opposing train can be sure of the conditions on the siding and readily identify the train by the engine number if need be, providing the number is stenciled across the front of the headlight in large figures. The green being a mild light does not blind the men coming toward it.

During the test this headlight was placed in the worst position possible to obscure signals at block station, yet men on fast trains were able to recognize the color of blocks without difficulty.

The inventor naturally turned to compressed air as a motive power, but prac-



MECHANISM FOR GREEN SHADE ON HEADLIGHT.

tical experience had told him that the air pump already had all it could well attend to, so he bent his energy to produce a machine that would do the work with the least air possible and have no leaks to supply.

This he accomplishes by means of the device shown in the accompanying line sketch. A and A1 are two cylinders placed one above the other and connected by a small port c. This port is opened and closed by valve f. A is a cylinder 1 in. in diameter and 2 ins. stroke. It has a piston whose rod B extends through port H which serves as a guide and has on its end a sort of crosshead C having two arms, one extending sidewise and is the point of connection. The other arm extends below and in line with the rod, making a sort of extension of the rod on a lower level. A1 is a smaller cylinder having a very short stroke and ½ in. diameter. This cylinder is the point of entry for the air supply, it being threaded part of its length to receive a ¼ in. pipe. This cylinder also has a piston whose rod B1 also extends through guide port H and terminates at a point nearly above the point of extreme travel of the lower arm of the crosshead C. D is a tee-shaped catch or lock which is pivoted at the stem and cross-piece and hung between two posts I and I, with the stem of the tee in horizontal position. The top arm rests against the end of piston rod B1, so that when the piston is driven out to its extreme travel the stem of this lock is slightly above the horizontal. The lower arm extends down in line with the lower arm of crosshead C, so as to be engaged by this arm and be forced back by it until the stem of this catch or lock D is in the horizontal position, when piston and rod B are at their extreme outward travel. In this position the catch on the stem is hooked over the crosshead C, holding it in this position. Valve f is operated by valve rod f1, it getting its action from the side arm of the crosshead C by means of two lugs g and g1. The device is operated by a three way cock in the cab.

To cover the headlight, turn the three way cock to application position and leave it about three or four seconds and return to release, when all air is exhausted, except that in cylinder A, so leakage cuts no figure. In this time air has filled cylinder A1, fed through port c to cylinder A, driven piston and rod B out until the lower arm of crosshead C engages the lower arm of tee clutch D, forcing it back and causing it to engage the crosshead C through the catch on its stem. Just at this point the lateral arm of crosshead C has engaged lug g1 and caused valve rod f1 and valve f to move and shut off air from cylinder A. Cylinder A being twice the diameter of cylinder A1, it is able to do its work and at the same time overcome the pressure in cylinder A1, so that when the lower arm of the tee clutch B is engaged by the lower arm of crosshead C, it is forced back, while the upper arm is forced forward and with it piston and piston rod B1. At this point the three way cock in the cab has been turned to exhaust position, the air in cylinder A1 escapes to the atmosphere, while that in A slowly leaks away, the valve f having closed port e. The lateral arm of crosshead C is connected to the short arm of bell crank K by means of rod J, the long arm of bell crank K is connected to carriage M by rod L. This carriage slides on two guides n and n1, and carries the green glass cylinder which changes the color of the light. This carriage and cylinder passing up and around the burner of the headlight through an opening made by cutting away that part of the reflector just below the burner which always shows in shadow no matter how clean the reflector may be. Thus it will be seen that as piston and rod B moves out, the green cylinder is raised and once the crosshead C is caught and

held by the tee-clutch D; the green shade is also held in position by means of rods J and L and bell crank K without air pressure being then in any part of the device.

Wishing to uncover the headlight, the operator simply turns the three way cock to application position and immediately returns it to release or exhaust position. The air from the three way cock passes through pipe to cylinder A1 and drives piston and rod B1 out, forcing the top arm of the tee-clutch D back and raising its stem, letting crosshead C free. The weight of carriage M and its glass cylinder acting on piston B through bell crank K and crosshead C and their connecting rods J and L forces it back into the cylinder. Valve f being closed, the fall of the green shade is comparatively slow owing to the slight compression in cylinder A owing to valve f being closed, so that the air in cylinder A1 has ample time to be exhausted before the valve f is opened by the lateral arm of crosshead C engaging lug g on valve rod f1 just before carriage M comes to rest and with it the other parts of the device.

From the foregoing it will be seen that this device is unlike any other of its kind. It wastes no air for more than four seconds to an operation. The operator is compelled to keep the air shut off from the device no matter what the position of the shade may be by reason of the construction of the device. The amount of air used depends on the length of piping between the cab and headlight.

The device being fastened to the bottom board of the reflector it is necessary to use a short hose inside the headlight case so that the reflector can be pulled out to light, etc. A ball union is used, so the reflector can quickly be exchanged or taken out for cleaning.

Meadville, Pa. JOHN FIX.

Hydrostatics.

Editor:

In a recent article in your interesting series, "Elements of Physical Science," you state that water submitted to a pressure of ten thousand pounds to the square inch loses one-thirty-sixth of its bulk. My experience in the use of high pressure in hydraulic appliances has not led me to believe that the compression of the fluid would amount to so much. I would be very glad if you could confirm this or give me the source of your information, so that I could correct my own impressions.

J. W. NELSON.

Manager R. Dudgeon's Machine and Hydraulic Jack Works.

New York.

[The compressibility of water is treated at considerable length in an excellent work by Prof. G. P. Quackenbos, LL.D. His figures show that a pressure of fifteen thousand pounds per square inch will compress water one twenty fourth of its volume. Our figures are about the same in relative proportion. Prof. Everett's work on "Units and Physical Constants" and an exhaustive treatise in the Encyclopedia Britannica also nearly agree on a relative ratio. Prof. Everett's tables are particularly interesting. The experiments are largely based on atmospheric pressure.—Ed.]

King of the Continent.

Editor:

There has been a lot of talk lately about electricity as a motive power putting steam in a back seat. This may be happening on short suburban runs, but when it comes to transcontinental distances, here are my sentiments:

THE KING OF THE CONTINENT.

Oh, "electric juice" is all the rage,
And it's sure a wonderful thing;
It's taking its place on history's page
And it's making our door-bells ring!
But the old steam engine is still in date
And it's going to stay a while,
And "electric powers" will have to wait
Till steam goes out of style.
Oh, the locomotive they're laughing at
Is all to the good, you bet!
When it comes to covering leagues of land
At a pace that's sure and a speed that's grand
This wonderful creature is still on hand,
It's king of the continent yet.

I enclose a photograph of the king of the continent, covering his leagues of land at a mile-a-minute pace.

A. P. PAYSON.

New York City.

Broken Air Pipes.

Editor:

In my letter on the subject of broken air pipes which appeared in the October number, the flow of air under the different conditions was not explained in detail; it was at the time considered sufficient, but it appears that some of the explanations should have been made clearer, especially where it was stated that the automatic brake on the train could be operated from an engine equipped with the E. T. brake if the brake pipe was torn from the engine.

As it was stated, if the brake pipe was torn from the engine the brake valve handle could be placed in emergency position to prevent the escape of air from the main reservoir, the engine and tender brake could then be released by means of the independent brake valve and the pipe leading from the distributing to the tender brake cylinder coupled with the train brake pipe by driving together the hose couplings between the engine and tender.

The stop-cock to the driver brake cylinders should be closed before uniting the hose couplings, as some of the triple valves in the train may be leaking into the brake pipe, and if the volume of leakage was sufficient, would apply the driver brake, the handle of the independent brake valve should be held in release position while this is being done to prevent pressure from building up in the application chamber of the distributing valve through the ports m and n as the equalizing valve will have assumed the emergengy position when the brake pipe was broken with its packing ring and the cover gasket forming a joint which will prevent leakage to the atmosphere.

After the adjusting nut of the safety valve is screwed down and the handle of the independent valve placed in application position the reducing valve will admit 45 lbs. pressure to the application and pressure chambers of the distributing valve forcing the main piston to application position and admitting a like amount, from the main reservoir, to the brake cylinder pipe on the engine and the train brake pipe on the tender and train.

It was also stated that the pressure in the application chamber could be increased to any figure desired, 70 or 110 lbs., by screwing up the adjusting nut of the reducing valve, and the main piston would allow a like amount to flow into the train brake pipe so long as the main reservoir contains the required pressure and volume.

The ports m and n will allow a continuous flow of main reservoir pressure to the application and pressure chambers of the distributing valve, but as the entire train signal system is connected with the application chamber when the handle of the independent brake valve is in application position, the flow of air through the small ports is not sufficient to increase the pressure beyond the adjustment of the reducing valve. When an application of the brake is desired and the handle of the independent brake valve placed in release position the main piston will assume the duties of the brake valve equalizing piston, exhausting brake pipe pressure until it is equal to that remain-

ing in the application chamber the single pointer gauge will show these pressures.

As it was stated in the letter mentioned, the reduction should be almost continuous until the train has stopped on account of the ports m and n building up application chamber pressure; for, in this position of the brake valve, the signal system is no longer connected with the application chamber.

On account of the size of the port connecting the two chambers the pressure will be withdrawn from the application chamber faster than it can flow from the pressure chamber and if the pressure is allowed to increase in the application chamber it will move the main piston to its application position, closing the brake pipe exhaust and permitting more pressure to flow into the brake pipe.

The pressure in the equalizing reservoir of the automatic brake valve will leak past the equalizing piston packing ring to the atmosphere and in a short time the gauge will show no pressure in this reservoir, and as the independent brake valve handle is moved to make the application, a reduction in the application chamber will occur when the handle reaches running position, due to the pressure flowing to the equalizing reservoir. If this is found undesirable the automatic brake valve handle can be placed in service, or lap position.

This method of handling a train not only applies to a broken brake pipe, but also to a case where both the main reservoir and few valve pipes are broken; or where the automatic brake valve is disabled from a broken body or a twisted or broken rotary key, it will only be necessary to stop the main reservoir leak and proceed as previously stated.

This appears even simpler when the break occurs with the later H 6 equipment, as there are no ports m and n in the distributing valve, and in case of the broken brake pipe the handle of the automatic brake valve can be returned to service position which will prevent the flow of air from the feed valve pipe to the application chamber of the distributing valve.

When the brake valve is broken or all the pipes broken, so there is no air pressure on the brake valve the position of the handle is of no consequence.

When the brake valve cut-out cock is located in the main reservoir pipe with the H 6 equipment a check valve is placed in the pipe which conducts pressure from the rotary valve and feed valve pipe to the application chamber pipe during emergency applications.

This check valve prevents a backward flow of air which might unseat the rotary valve and allow the application chamber pressure to escape at times when there is no air pressure on top of the rotary valve which may occur when the engine is the second one in double-heading, should the brake valve on the first engine be allowed to remain in application position until all the brake pressure has escaped.

Therefore, it will be noted that if the H 6 brake equipment with the cut-out cock in the reservoir pipe is used to operate the train brake while there is no pressure in the automatic brake valve this check valve will prevent a flow of air from the application chamber.

When the stop-cock is located in the brake pipe of the H 6 equipment, this check valve is not used, and if the brake is to be operated under the conditions mentioned this branch pipe between the automatic brake valve and application chamber pipe should be blanked.

From the construction of the independent valve used with the H 6 brake valve, it will be noticed that when the handle is in running position the exhaust port of the distributing valve is open to the automatic brake valve and while the equalizing valve is in application position the exhaust port is lapped and no reduction in application chamber pressure will occur until the handle is moved to release position.

Referring again to the letter published in the October number it states that if the application chamber pipe is broken the application chamber leak could be plugged and the double heading pipe disconnected to form an exhaust for the application chamber pressure and the driver brake used during automatic applications with the H 5 brake equipment the application chamber pipe is the lower one while with the H 6 brake the application chamber pipe is the upper one and if broken and plugged the lower one should not be disturbed, as it would destroy the driver brake holding feature. To plug this pipe would be equivalent to plugging the exhaust port of a triple valve.

On account of the length of the brake pipe on modern locomotives some difficulty in obtaining full brake cylinder pressure on the train during emergency applications has been experienced when double-heading; for this reason the tenders on some locomotives are equipped with a quick action triple valve in addition to the E. T. brake.

The standard straight air brake double-seated check valve being used between the triple valve and brake cylinder with the pipe form the distributing valve connected to the straight air side.

When the tender is equipped in this manner it can be used with an engine equipped with the ordinary automatic brake with the combined automatic and straight air brake or with the E. T. brake.

When used with the E. T. brake the stop cock in the pipe leading from the distributing valve to the tender brake should be left open while the triple valve is in service.

When the triple valve is cut out the stop cock should also be closed, and if this cock is left closed when the triple valve is again cut in a slight leak past the gasket on the straight air side of the check valve will allow pressure to build up in the pipe between the check valve and stop cock during applications of the brake, and as the triple valve starts to reduce the pressure in the brake cylinder when the brake is released this stored up pressure will force the check valve over, cutting off the flow of air from the triple valve.

When the brake is stuck in this way it cannot be bled off; the only way it can be released is by opening the stop cock or disconnecting the hose between the engine and tender.

G. W. Kiehm.

Washington, D. C.

A Freak That Was Missed.

Editor:

I have been reading Sinclair's "History of the Development of the Locomotive Engine," and have been particularly interested in the chapter on Freak Locomotives; but I find that one celebrated freak has been omitted. That freak was known as the Swinerton Locomotive, and was very much in evidence in New England in 1888. The designer of that locomotive conceived the idea that driving wheels covered with flat facets would adhere more tenaciously to the rail than those with a true round surface. A locomotive was built to put that idea into practice, a single pair of 5-ft. driving wheels being used with 105 flat milled spots on the outside of the tire.

In looking over my bound volumes of The Locomotive Engineer I found that the editor made fun of the claims made for the Swinerton engine, and that for months he permitted the inventors to do their best with the locomotive without embarrassing them with criticism. Then he gave them a final blast as follows:

"When the Swinerton locomotive came tap-tapping along with 105 flat spots and 41,000 pounds on a single pair of drivers, this paper was taken to task by some of the Boston stockholders for condemning 'a new departure in locomotive practice before it could be tried.' So we agreed to keep still for six months, which we have done.

"We have watched this engine's performance, and find that she has spent as much time on the jacks as on the road; that her flat spots have got their corners knocked off, and that she has never made twenty-five miles at a stretch without getting her driving boxes too hot for safety. She has had some of the weight transferred from the drivers to other wheels, and new axle and driving boxes.

"The engine was built in defiance of

two well-known laws of mechanics—the inventor claiming that increasing the area of surface in contact with the rail increased the adhesion, and that he could carry much more weight on a single pair of driving wheels than exhaustive experiments had shown could be carried. In both these attempts he has failed."

It is needless to add that the Swinerton locomotive stands among the monumental failures of the amateur locomotive designer.

General Foreman.

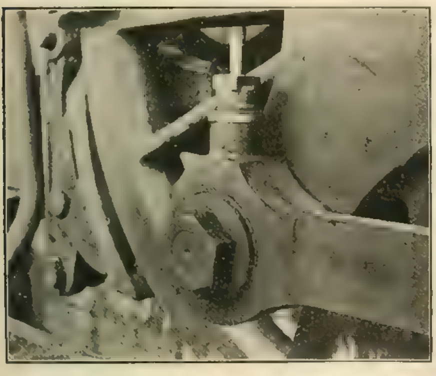
Boston, Mass.

Grease Cup Plug Holder.

Editor:

I am sending you for publication a snap shot picture taken of a safety device which I have got up to prevent grease plugs from being jarred loose and getting lost. This device is now being tried on the Erie Railroad and so far has proved very successful.

The device is a spring 1/16 in. thick and ⅜ in. wide, bent in a true circle about ¼ in. smaller than the outside diameter of the rod cup, and it is tempered. In the center of this spring is a



GREASE CUP PLUG HOLDER.

3/16 in. dowel, rivetted in, that is long enough to go through the side of the oil cup and inside about ⅛ in. A hole, ¼ in. in diameter, is drilled through the oil cup about ⅜ in. down from the top. The dowel in the spring goes through this hole and engages in a groove cut in the grease plug. This groove is cut to a square shoulder on the left side and tapers out on the right side, which allows the plug to be screwed farther in the cup without having to remove the spring, and the tension of the spring outside of the cup holds the dowel in the groove and does not permit the plug to screw out by jarring.

In order to fill the cup with new grease the spring is pulled out far enough to let the dowel come outside the oil cup, and then it can be turned a little to one side and the plug can easily be screwed out.

As soon as the plug is put back the spring can be turned back and the dowel will snap in the hole and engage with the groove in the plug. The ends of the spring are bent back a little, which gives a good chance to get a hold on the spring to remove it. On some roads the loss of grease plugs is a big item of expense, and it will be found that this device will soon do away with such loss.

We all know that if an engine is not stopped in just the right position that

THE "YANKEE" IN AUSTRALIA.

it is an impossibility to get at the jam nut on the grease plug in order to get it out to refill the cup. With this device the plug can be easily removed and replaced, and even if it can't be screwed in tight it will be safe, for the dowel will prevent its coming out. Another thing to be considered is that several of these springs can be carried on the engine, so that if one breaks it is an easy matter to replace it.

H. L. Burrhus,
Erecting Shop Foreman, Erie Rd.
Hornell, N. Y.

Present and Past in Australia.

Editor:

I am enclosing some photographs, two of goods engines. One was built here in the city of Marysborough, the other is a Baldwin. I am "taken" with both engines. The "Yankee" is not a great favorite, as some of the boys get sick when they have to run her. The other photograph is of the oldest or rather the first engineer who drove the first locomotive

AUSTRALIAN GOODS ENGINE.

engine in Australia, also his fireman. This might be of interest to your readers. The first trip was from Sydney to Parramata. I was personally acquainted with these men. F. Anschan.

Marysborough, Australia.

Suggestion for 9½ In. Pump.

Editor:

There is no denying the fact that the 9½ in. pump has proved itself to be a faithful servant in years gone by, and the fact that it is still standard on up-to-date locomotives, in spite of attempted improvements, adds still more to its credit. There is one point in its construction, however, which could be considered weak, and no doubt has cost railroad companies quite a little.

The life of the steam head, aside from the renewal of bushings, would be unlimited, were it not for the thinness of the casting at the point where the reversing chamber cap screws into the head, ant it would not be exaggerating to say that nine-tenths of the heads are relegated to the scrap bin on account of cracks and breaks at this point. The four holes which are drilled through the chamber to form the ports and plugged with brass on the outside add to its weakness, and often crack when bushings are renewed. The use of the eye bolt when hanging a pump is often the primary cause of breaks. Of course there are makeshift repairs, such as the shrinking of bands, caulking, etc., but I think every air pump repairman in the land would

ENGINEER AND FIREMAN OF FIRST LOCOMOTIVE IN AUSTRALIA.

rise as one, and salaam, if this would be remedied. Of course there are no "adding on" tools in shop practice, but a little more stock from the foundry would be appreciated.

Allen E. Nye,
Air Room Foreman, A. T. & S. F. Ry.
Albuquerque, New Mex.

Broken, But Why?

Editor:

A left back-up U-bolt eccentric had been loose and running warm, lukewarm in fact. At the top of a hill train broke in two about thirty-five car lengths from engine. When stopped the slack of the train was all out, and when the engine started to back it had made about three exhausts when the slack all ran down against engine and shoved it ahead about one revolution, and in doing so the left back-up eccentric and strap were smashed. What

caused the breakage when the eccentric was not hot and only slipped about a quarter of an inch on the axle and the any of your readers solve this problem? valves were in excellent condition. Can

Terre Haute, Ind. H. P.

Good Boring Bar.

Editor:

The boring bar shown on the drawing sent herewith was designed more especially for boring car wheels, where a bar of very rigid construction was needed. This bar, as will be seen, can be very quickly and easily adjusted, inwardly or outwardly as needed, by the

ADJUSTABLE BORING BAR.

right and left hand screw which passes through the tool blocks. The blocks are securely clamped by the binding screw at the bottom.

We have found in our use of this tool for over two years that we can bore out a wheel with one cut, regardless of the amount of stock to be removed, and with a feed of ¼ in. per revolution. The cutting tools are simply flat pieces of self-hardening steel, both cut to the same length and may be made of any size to suit conditions. We are using on our 4-inch bar steel ⅝ x 1¾ ins. cut from the bar of that size. One wrench is all that is needed to adjust the tools; we use a double ended box wrench, one end to fit the adjusting screw and clamping screw and the other end to fit the set screws which hold the cutters. We have found this the best bar we have ever used for boring wheels to fit the axle, which is now our general practice.

While this bar was designed for boring wheels on a vertical boring mill, it can also be used on the horizontal mill for boring rod brasses and similar work and can be used on the turret lathe as a chucking reamer. This bar is in use on the Pennsylvania lines at quite a number of shops and has proved very satisfactory.

Mr. William Chase, Jr., general foreman of the P. C. C. & St. L. Ry. Indianapolis shops, was the inventor and patentee of this bar and he can be addressed at No. 33 North State avenue, Indianapolis, Ind., by those desiring further information.

D. A. Osswald,
P. C. C. & St. L. Ry. Shops.
Indianapolis, Ind.

Side Rod Bushings.

Editor:

After reading several articles in Railway and Locomotive Engineering, I submit the following article for publication concerning side rod bushings:

Some railroads leave a collar on the inside of the side rod bushing to prevent the side rod from working in toward the hub of the wheel, for as soon as a rod bushing gets loose it allows the rod to hit the counterbalance or wheel center and the result is that there is generally a set of rods in the shop for repairs.

On most roads the one idea is to keep the rods away from the counterbalance or hub, for they consider that the chief danger, but from my personal experience with rods I find that when an engine comes into the round house with crank pin nuts and washer gone that side rods are also missing.

I believe that both sides of the crank pin should be protected, for I have seen several cases of back and front ends of side rods rubbing the collar and the action of steel rubbing steel causes such a hot pin that serious delays are caused. To overcome this, I suggest the use of a double collar bushing, or, in other words, a bushing having a collar at least ½ in. larger than the bore in the rod on both sides of the rod. At first this idea was laughed at and some said that it couldn't be done with a bushing, but it is very easy, for all we had to do was to cut the bushing in two and simply press in the two, half-bushings.

The only objection I could hear of was that where the two bushings come together in the center of the rod they would leave a crease in the pin, but this crease is so small that it can easily be filed down. On the other hand, this style of bushing was perfect, for it held the rod in place. Another thing to be considered was that even if the bushings got loose and turned past the oil hole, the pin would still get oil through the crack where the two bushings meet. Still another good point is that even if one of the bushings is a little loose the other one might still be tight and the rod would be in fair condition for road service.

I have seen so much trouble with set screws put in the bottom of rods to hold the bushing in place that I can safely say that it is only money wasted to put them in. With the double bushing there is not any need of a set screw, and this alone is quite a saving.

Some machine men might consider it a hard job to turn and bore this kind of a bushing. The bushing can be chucked in a lathe and bored for crank pin and turned on the outside for rod fit. One collar can be finished, preferrably the inside one, and then the bushing cut in two with a narrow parting tool. The other collar can be now finished very easily.

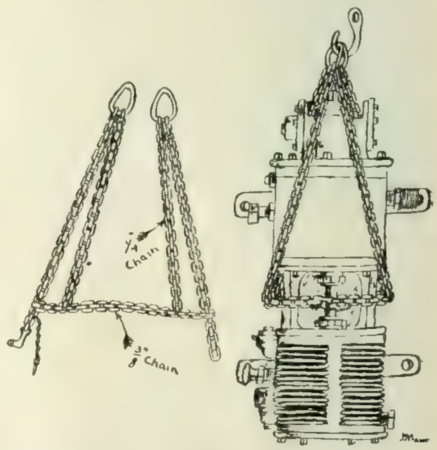
My experience proves it is a good idea to have the bushings about 1/64 of an inch apart and then allow 1/32 of an inch lateral. At the most, the rod can only have 3/64 of an inch side play, and this is such a small amount that unnecessary rod failure will soon get to be a thing of the past.

H. L. Burrhus.
Hornell, N. Y.

Chain Lifter for Air Pumps.

Editor:

I send you the enclosed sketch which is an explanation at the same time. The chain hoist has been used by the writer with remarkable success in hoisting air pumps up to their brackets on locomotives. This does away with the dangerous methods heretofore used, such as an eye-bolt



CHAIR LIFTS FOR AIR PUMPS.

secured in the top head of the pump. The eye-bolt has a tendency to strip the thread in the head. Hoping this may be of interest to your readers.

Milwaukee, Wis. M. A. Shuster.

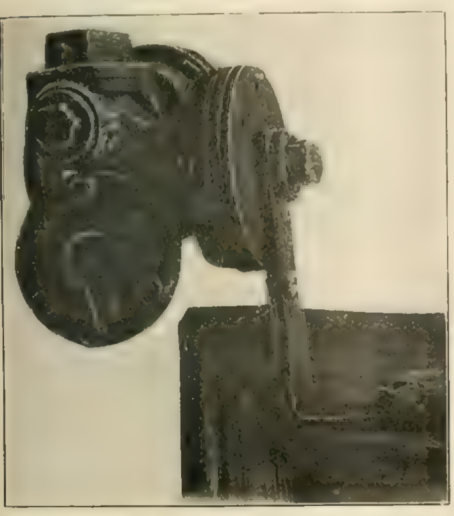
The E. T. Brake.

Editor:

Mr. G. W. Kiehm's article on the E. T. brake in January's Railway and Locomotive Engineering I have read with interest and learned much therefrom. We have had nothing on main line passenger trains but engines equipped with the E. T. brake for the past two years, and have had some pretty tough experiences, from which I profited. The part where Mr.

Kiehm says: "If the brake cylinder and pipe connections are tight, the distributing valve will exhaust the brake cylinder pressure as the application chamber pressure reduces, but if the brake cylinder leaks can reduce the pressure as fast or faster than the application chamber pressure reduces, the brake will leak off without giving any warning."

This is true, but I claim brakes will not leak off without giving warning, for if



HANDY TRIPLE HOLDER.

there is a brake cylinder leak, assuming that the B-3 reducing valve is working properly when independent brake is applied and independent brake valve handle left on application position, pressure in application chamber will be 45 lbs. and a like amount will flow to the brake cylinders when grduating spring in application piston will move the application piston far enough to the left to lap application valve or independent lap.

Now, if there is a leak in brake cylinder pressure I claim warning will be given and should be heeded and trouble remedied. The warning is the falling and rising of independent gauge hand with independent brake applied and valve handle left on application. The rapidity with which the independent gauge hand falls should determine whether brake cylinder leak is large or small; also the amount gauge hand falls before it begins to rise should determine the sensitiveness of the application piston.

I would like to see a discussion of the diseases and remedies and how to detect trouble in the E. T. equipment and before it becomes a disease, participated in by all the air brake repair men who have to deal with this brake, as I feel we all could learn thereby. I inclose a picture of a vise or device with which I hold distributing valves while cleaning them. Valve can be turned in any direction over and over or any way, and it is very convenient and easily made.

George C. McDougal.

A B Dept., A. C. L. Ry., Sanford, Fla.

Triple Valve Release Test Feeds.

Editor:

I read with considerable interest the article, "Cleaning Locomotive Triple Valves" in the February number of Railway and Locomotive Engineering, and am sure such matter is bound to be fruitful at least to some extent. As regards the mentioned test for bent emergency valves, that is, inserting the small end in the emergency piston, I would scarcely think satisfactory, as sometimes the men cleaning valves may not have good judgment in performing this test, and I believe it is better to change all emergency valves and let the removed ones go to the shop to be overhauled. I have seen this carried out with entire satisfaction.

There is one subject which seems to be neglected in most articles on the triple valve and that is the pounding up of the emergency piston guide in the brass seat. It is well known that frequent emergency applications will cause the emergency piston to pound on the guide, and the consequence is that the emergency piston will bind in the guide and hold the emergency valve off its seat. I will here relate the result of some tests made on our road which showed somewhat surprising results. The test was made, before cleaning, of all triple valves removed from freight cars and coaches for a few months to ascertain defects, etc. During that time 1,269 quick action valves were tested and 145 were found to have emergency pistons sticking or binding in the guide. In three cases flat wheels were caused. In most cases the piston could be returned to normal position by jarring the triple, and consequently it is to be presumed that the piston would return when the car was running on the road. This result shows over 11 per cent. of the valves tested had this defect to some extent.

It is my opinion the difficulty could be practically eliminated by reaming out the top of the guide, so as to give it a bevel of about 45 degs. and about ⅛ in. deep.

A few words might also be said about testing triple valves, especially in regard to the release test. Of course to test triples properly we must use a test rack specially adapted, and a good many of these racks are now in use in various parts of the country and usually have a train-line feed up of 8 to 10 lbs. per minute for the release test. A feed-up of 8 lbs. or over is too much for giving the best results in freight service. I have seen triples released with these feeds which had packing rings that leaked 35 lbs. into the auxiliary in one minute with 70 lbs. train-line pressure. How is this valve going to release on the rear of a sixty car train, especially if the engineer happens to move to running position a little too soon, or in cold weather, when train pipe leaks are abundant?

As a rule a more severe test is used for repaired triples, against which there is no objection, but let us be a little more severe in our cleaner's test, that is, for the release of triple. I have seen for over three years a 6 lb. feed up used for [illegible] valves, and the result was all that could be desired. This feed would release any triple in good condition, but if the packing ring leakage was over 18 lbs. per minute the valve would not be released. It would then be tested for packing ring, and if no improvement could be made the valve was "condemned" and sent to the shops for repairs. I believe if the 6-lb. feed up was used all the time for freight triple valves the percentage of "condemned" would not be as large as might be expected and the results obtained would prove the worth [illegible]

[illegible]

Winnipeg, Man.

Driving Box Brasses.

Editor:

Kindly correct typographical error in the fifth paragraph on page 61 in my article on the "Proposed Changes in Driving Boxes," which should read thus: The proposed design of driving boxes would engage the driving box *brasses* of the present dimensions, as the longer end of the box may project over the *brass*, etc. The two words in italics were printed *house*. Some people might conclude that I am introducing new terms.

James Francis.

Carbondale, Pa.

Portland Express on the B. & M.

Editor:

I have just been reading your interesting article on the "Continental Limited" on the Boston & Maine Road, and I am sending you a photo. of one of the big ten-wheelers used on this and other fast trains on this road.

PORTLAND EXPRESS ON THE B. & M.

In this picture the engine is not hauling the "Continental" but a Portland express, and was taken as the train was passing through the West Lynn yard on the Eastern division.

F. S. Wyman.

Waltham, Mass.

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Smoke From Switching Engines.

No form of steam making furnace is so difficult to operate without creating smoke as that in a locomotive boiler when the engine is doing fluctuating work. There is no form of steam engine that works so irregularly as a switching locomotive. For a few minutes such an engine will be working as hard as a full-open throttle will drive the engine in full gear, then the steam will suddenly be shut off after the fire has been stimulated to the utmost by the fierce exhaust. No care, ingenuity or air-admitting mechanism can prevent a locomotive from causing smoke when worked with the extremes of light and high power common to all switching engines. Constant care on the part of the fireman will keep the smoke from being very conspicuous, but smoke there will be in evidence, no matter what may be tried to prevent it.

The smoke that escapes from a few locomotives or from the chimneys of a few factories is not detrimental to health, unless it goes out in volumes that hold down sulphurous gases to the level of dwellings, a condition sometimes found in Pittsburgh and other metal smelting cities, but a certain class of quasi-scientists make cheap capital by denouncing smoke as a menace to health, and public sentiment is aroused which leads to periodical crusades against the smoke nuisance. Defective drainage and inferior ventilation of houses are much more dangerous to health than the worst smoke-spreading furnaces, but the danger of vitiated air and poisonous earth emanations are not conspicuous to the senses and so they escape the odium cast upon more harmless nuisances.

When a smoke preventive crusade is created in any town the switching locomotives nearly always receive the first attention of the health officers, and the railway company with their engine men are persecuted for causing smoke which they cannot prevent, while furnace owners whose plant could easily be rendered smokeless, are permitted with impunity to pollute the air with dense smoke clouds. Any furnace working under uniform conditions can be made smokeless if operated within its capacity. Smoke is generally caused by the furnaces being forced beyond their means of mixing the combustion gases.

The quasi-scientists are constantly telling that smoke means waste of fuel, and that coal burned without smoke produces the maximum of heat. That is another humbug. In laboratory experiments, when the exact quantity of air necessary to maintain combustion is admitted to the furnace, the maximum of heat will be generated when smoke is absent, but in an ordinary furnace excess of air must be admitted to the fire in order to provide the oxygen necessary to effect combustion, and heating the excess air wastes fuel. The most economical condition of combustion is to limit the supply of air to the point where smoke begins to be formed. All enginemen who have worked under the premium system for coal saving are aware that an unlimited supply of air means small premium money. The factory furnaces that give greatest cause for complaint on account of smoke are too small for the work they are compelled to do, and they produce smoke because they cannot admit sufficient air to effect complete combustion.

We are informed that government experts at Washington have been investigating the smoke prevention question, and that they have issued a bulletin showing how the pollution of the atmosphere by smoke could be avoided. The thing is ridiculous. All that ever has been learned about fuel combustion and smoke prevention was taught in science primers long before any of the Washington "experts" were born. The invention of smoke preventing appliances is older than the steam engine. As early as 1695 Denis Papin, a French philosopher, invented a furnace with a downward draft, an arrangement which was claimed to effect perfect combustion of the fuel with entire absence of smoke. As people not directly interested in steam boilers objected to smoke from the first time they appeared, the history of steam boiler development is closely associated with the invention of appliances designed to prevent smoke. In reading about the experience of boiler owners with various smoke preventing appliances, we often meet with the statement, "the invention works well when accompanied by *careful firing.*" No furnace has yet been made that could dispense with careful firing when smoke prevention was aimed at. Given a furnace not overworked that permits of air being admitted above the fire it will prevent the creation of smoke when handled by a careful fireman.

Reporting Work.

A great many locomotive engineers display singular unwillingness to enter reports in the work book after a trip, while others delight to display their handwriting to as great an extent as their ingenuity will command.

An old roundhouse foreman who had many years experience with engineers fond of reporting defects of their engines, always had hot shot ready for those who reported nuts loose, keys missing and similar defects that a careful engineer would repair himself. A favorite expression of this foreman was "A stitch in time saves nine, but do not make stitches unless they are needed."

Before proceeding to enter reports in the work book an engineer ought to examine his engine carefully and enter for repair or adjustment only the things that are necessary. To report a knock on the left hand side is very indefinite and gives the repairing machinist no information of what is likely to be causing the trouble. The intelligent engineer is in the best position to tell what causes the knock, and he ought not to cease investigating until he locates the defect. We once had a passenger engineer who nearly always reported at the end of each trip, "Left hand driving box pounding," which was varied at times by "Left hand back driving box pounding." After jacking up the engine twice to examine the driving box brasses, we finally discovered the trouble to be in a flat driving wheel tire.

"Valves blowing, air pump not working properly, injector to be examined," are common reports seen on work books, but engineers with any pride in

their business add more particulars for the guidance of the man who has to wrestle with the repair work. Tell the symptoms of the disorder and the machinist will locate the defect. One time that a very good repair machinist took down a main rod that was reported pounding badly he found nothing wrong, but could not make the simple test of trying for lost motion because the engine was cold when he began work on it. The real trouble was a loose piston head and it went out through the cylinder head before the engine went two miles away from the round house. That was an expensive penalty the company had to pay for ignorance.

Adjusting the Rods.

The fitting, adjustment and care of the main and side rods of locomotives are of more importance to the successful running of the motive power than is generally imagined. It might be said at the outset that while a constant care of the rods is a vital necessity, a correct construction of many other parts is a primal need, the absence of which no kind of care can make up. In this regard the fitting of the wedges to the driving boxes, the exact alignment of the wheels, the fitting of the brasses in the straps, and the careful first adjustment of the rods are all important. As in the mechanical details of railroad construction and repair work, generally there is an absurd haste as the work approaches completion. Hence it may be noted that locomotives that have been in the shop for several weeks undergoing general or special repairs, there is a maddening rush toward the end not called for, perhaps, by the requirements of the transportation department so much as by the desire to keep up or even beat some high water mark of a shop record.

If the wild rush at work was made during the early days of the repairing of the locomotive the effect would not be so pernicious, but it is no uncommon thing to see a leisurely straightening up of the pedestal jaws or valve seats and guides occupying several days with no great results, then as the time of completing the work approached the spurt comes on just as a mile runner astonishes the beholders with an unexpected burst of speed at the finish of the race. In the case of the runner it may mean a valuable prize, in the case of the repaired locomotive it is often a serious loss. Rods that are hastily stuck on to the crank pins will be heard from soon after and will continue to be heard from, beginning with the hot, dull grind of the first few days, and rapidly breaking into the compound rattle of a smithy's shop.

Assuming that there is time enough to adjust the rods properly, this is the way to do the job: Move the engine until the right main crank pin is on the forward centre. This will bring the left main crank pin on the top quarter. A string suspending two small weights may be readily hung over the left crank pin and the engine can be moved until the string shows that the crank pin is exactly central. In this position the main driving wheels should be securely blocked, and all the other wheels set to correspond. In raising the wheels it is well that blocks be placed between the bottom braces and the driving boxes so that the locomotive need not at any time lose its nearly level position. When the crank pins are set in equidistant position the rods can be readily adjusted to the right side. Care should be taken to attach one end of the rod and observe where the extreme end is pointing to.

It will be rarely found that it is pointing exactly central, and this is where the skilled mechanics show their fine hands in slightly adjusting the brass to bring the rod to the desired position. Both ends should be tried in this way, and in addition to pointing straight it should also be observed that there is no oblique divergence in the rod. This will be readily seen by the relation of the strap to the rod, and should be carefully looked for before attempting to drive the bolts in place. It is presumed that the wedges are snug in the driving boxes. The extreme piston stroke should also be marked on the guides, and in adjusting the main rod the clearance space should be nearly equally divided. A slight variation might be allowed if convenient in allowing a larger space in the front of the cylinder, as the driving of the rod keys has the effect of lengthening the main rod, and unless this tendency is counteracted by the careful adjustment of liners from time to time the space at the back of the piston stroke will be found to have increased considerably. When the side rods are coupled the bearings should all be sufficiently loose to be readily moved, and the engine should be moved until the pins are on the back centre, when they should be tried, and if found difficult of movement at any particular point the bearing should be removed and the readjustment of the rod begun again and the operation continued until every bearing is slightly movable at both forward and back centres. Time need not be wasted in experimenting with the bearings at other positions than on the centres, for the reason that it is only on the centre that the pins are immovable. In any other position they are very flexible in regard to their exact position, and as the rods are pulling in one direction or another, their movement is difficult and doubtful and, in short, no exact idea of their adjustment can be had on any other point except on the centers, and it is safe to presume that if the rods pass the centres easily there is no possibility of difficulty at any other point.

When the right side is properly adjusted, the left may be proceeded with in the same manner, care being taken that the crank pins on the left side are as nearly on the dead centre as possible. This is a point of great importance because in another position the pins are easily spread apart to accommodate a rod that may be a little too long or easily drawn together to accommodate a short rod. Even with the most careful workmanship it will be found that slight variations occur necessitating the removal of a slight portion of metal here, or the insertion of a thin liner there. In the matter of solid brasses in use on the side rods of many engines all that is necessary is that the brass be bored out, at least one sixty-fourth larger than the pin. They should be readily removable at both centres. In regard to the driving of the keys on the rods, much caution should always be exercised in hammering rod keys, the enormous strength of a wedge-shaped key being more apt to bend the brass bearings out of shape than is generally supposed. In no make of the modern locomotive does good judgment and experience show more readily or more continuously than in the adjustment of the rods.

Heat Value and Distribution of Coal.

The facts stated by Mr. J. G. Crawford, fuel engineer of the Chicago, Burlington & Quincy Railroad, in a paper recently read by him to the members of the Western Railroad Club are so interesting and instructive that we have made a few extracts for the benefit of our readers. The subject taken up in the paper was the influence of heat value and distribution on railway fuel cost.

This fuel cost is about 12 per cent. of the total operating expenses of a railroad. The heat value of coal may be determined by laboratory tests or by evaporation tests made on locomotives. This latter method is preferable, as the coal is then tested in actual service. The unit of coal comparison is the number of pounds of water evaporated by a pound of coal. This unit of comparison will be affected by the kind of coal used, class of engine, condition of engine, engine crew (especially the fireman) and the class of service.

Speaking of the class of engine, he says: "If possible, all the tests made on any road should be made on one class of engine. This is advisable in order that the coals tested at one end of the system can be compared with those tested at the other end without having to correct for the difference in evaporative efficiencies of the engines. Then dealing with the condition of engine he held that engines should al-

ways be in good condition, and this applies especially to condition of flues and firebox. Whether a brick arch is used or not, the conditions in this particular should be the same in all tests. The relative importance of the make-up of the engine crew is such that during a series of tests the same firemen should be used throughout, thus avoiding any difference on this account. It is not so important that the same engineers be used, for while one engineer may use more steam than the other, the ratio of the coal to the water used will not change materially.

In taking up the question of the class of service, he said: "Passenger is preferable to freight service on account of the more uniform conditions. It is desirable that the time between terminals, the time using steam and the weight of the trains shall be nearly uniform from day to day, and that the average of these values for all tests made with each kind of coal shall be nearly the same. When tests are conducted in freight service at least twice the length of time will be required to test one kind of coal, and the expense will be more than doubled on account of additional coal weighers being required."

What Mr. Crawford calls the organization of the test party is important. At each terminal a fuel tester is located to take charge of the supply and weighing of the test coal and to see that none of the weighed coal on the engine is used during its stay at the terminal. The coal weigher is relieved by an engine observer before the engine leaves the round house, and he stays with the engine until relieved by the coal weigher at the other terminal. The engine observer keeps record of coal, water, steam pressures, stops, shut-offs, etc., in a printed thumb-indexed note book made up of seven printed forms and three blank pages. From four to eight men are required to make the tests properly, according to whether one or two engines are used and whether they are single or double crewed.

Regarding the number of tests, he said: "Exclusive of that used for firing up, about 150 tons of each kind of coal should be used on the tests. From six to eight round trips are made with each coal, and where two firemen are used half the tests are made with each fireman. This is necessary, as one fireman might be slightly better than the other. Tests in one direction on account of grades, speed or number of cars may be more favorable than in the other, hence the same number of trips in each direction are necessary.

"Then as to results the data taken for each test are recorded on blanks and the more important totals and averages recorded on the final result sheet. The data and computations of each test are recorded in a column and the average for all tests in the average column. In a series of tests which have all been conducted under similar conditions, the heat value of each coal is proportional to the average of items which shows the equivalent number of pounds of water evaporated from and at 212 degrees per pound of coal."

Having obtained the relative heat values of the various kinds of coal and knowing the cost of each, Mr. Crawford then developed a plan for the distribution of coal to each of the coaling stations, on a railroad founded upon the consideration of these items. The figures on the present and proposed coal distribution on a railroad taken as an example showed a daily saving of over $1,000. It lessened the coal consumed, the miles hauled, the first cost, and the handling cost. Speaking of this example, he says:

"It is not expected that every railroad company in working out a coal distribution would find that there could be a saving of over 12 per cent. made by distributing the coal according to the methods herein outlined, but there is no doubt but what considerable saving is to be effected on most systems.

"The relative importance of fuel and oil economy has often been mentioned, but by way of comparison it may be said that a saving of about two per cent. in the fuel bill would pay for the entire amount of oil and waste used for locomotive lubrication, and many railroads can save several times the amount of the lubrication bill by perfecting their system of coal purchase and distribution.

"During the last fiscal year the average cost of fuel for locomotives and lubrication for locomotives on several leading western roads was as follows:

		P. C.
Fuel for locomotives...	$6,042,266	13.2
Lubrication for locomotives	148,160	.3
Total operating expenses	45,604,823	100

"This shows that the cost of lubrication of locomotives amounts to only 2.5 per cent. of the cost of fuel for locomotives and that at least forty times the energy that is now spent in reducing the cost of lubrication should be expended on the fuel item.

"It is not expected that any railroad can at all times distribute coal according to some predetermined plan, but the cost of fuel will be considerably less, when purchased and distributed according to its heat value and cost, than when purchased and distributed in a semi hap-hazard manner.

"The greatest saving can probably be effected when the commercial demand is not at a maximum, which will prove beneficial to purchase and distribution by allowing more economical coals to be used and correspondingly less amounts of the less ecomonical coals."

Report on Superheaters.

The exact status of the locomotive superheater is likely to be fully reported to next Master Mechanics' Convention, for a strong committee with Mr. H. H. Vaughn at their head, are collecting facts and making some experiments with superheaters in different classes of service. The other members of this important committee are Messrs. Le Grand Parish and R. D. Hawkins. The committee have sent out a circular of inquiry, which is very comprehensive and is calculated to bring out all the information concerning superheaters that experience has made available. We trust that every railroad man in the country having experience with superheaters will tell the committee what they know. It is a good plan to answer the circular of inquiry as soon as it is received.

The locomotive superheater holds at present a position similar to the position held by certain smoke stacks when stack spark arresters were in vogue. It is a little too much in the hands of its friends, who are inclined to magnify its virtues and to conceal its shortcomings. In the long run the superheater will endure or depart on its merits alone. The sooner the real value of the appliance is demonstrated the better it will be for all concerned.

Exhibition of Safety Appliances.

Official announcement has just been made that an exposition lasting two months, will be held early in April in New York, under the auspices of the American Museum of Safety Devices and Industrial Hygiene, for showing the best methods of safeguarding workmen and protecting the general public. The exhibits will consist of safety devices, protected machinery in actual operation, models and photographs. During the exposition illustrated lectures by engineers will explain industrial conditions and hazardous occupations, and the most approved methods of securing safety.

Believing that many accidents are preventable and to stimulate further invention of safety appliances, three solid gold medals are offered for the best safety device• in the field of transportation, mining, motor vehicles and motor boats. Two prizes of $100 each, one for the best essay on "The Economic Waste Due to Accidents," the other on "The Economic Waste Due to Occupational Diseases," are offered.

The chairman of the committee of

direction is Mr. Charles Kirchhoff, and of the committee of exhibits, Prof. F. R. Hutton. There will be no charge for space. All inquiries and applications for space should be made to Dr. W. H. Tolman, at the museum, 231 West 39th street, New York City.

Air Brake Car C. R. R. of N. J.

The Central Railroad of New Jersey have recently put in service an air brake instruction car which is one of the most modern examples of this style of "school car" which we have seen. The car, as will be seen from our half-tone illustration, is a substantial seventy-foot coach mounted on a pair of six-wheel trucks, and was designed by Mr. B. P. Flory, mechanical engineer of the road, and by Mr. G. W. Rink, chief draughtsman, under the supervision of Mr. Wm. McIntosh, the well-known superintendent of motive power of the C. R. R. of N. J. The car was built at the company's Elizabethport car shops, of which Mr. Wm. Alter is general foreman.

The instruction compartment, which is 56 ft. 2 in. long by 8 ft. 7½ in. wide, is provided with a 50-car freight air brake equipment, besides two driver brake, one tender brake and one passenger brake equipment, all securely attached to a wrought iron framework extending along both sides of the room. In addition to this a 10-in. passenger brake cylinder, with slack adjuster and P 1 triple in tandem is mounted on a crane, hinged at one side of the car. Directly opposite, and on a line with the instructor's table is another crane supporting two 10-in. brake cylinders with K and L triples and sectional triples arranged in tandem. Five of the freight cylinders are equipped with a high speed reducing valve which can be cut in so as to operate as a passenger train. All freight cylinders are provided with a double bracket for the attachment of a "K" and "H" triple valve, either of which may be cut in service, or both cut out entirely.

INTERIOR OF THE AIR BRAKE INSTRUCTION CAR, C. R. R. OF N. J.

The brake piping is arranged in sections resting on the regular car flooring with a false flooring above securely fastened to the subsills extending longitudinally with the instruction room. Any portion of this false flooring can readily be removed for the inspection of piping. By the use of cut-out cocks it is possible to cut in groups of cylinders, corresponding to 5, 10, 20, 30, 40, 45 and 50 cars. The auxiliaries for the driver, tender and passenger cylinders are located under the car. The air signal instruction apparatus consists of a twelve-car train equipment and is located under the lower deck on each side of the car.

In this car the piping required for a 50-car train is actually used. In some air brake cars an equivalent volume is used, but in this case the piping which would be used in a train of that length is carried. There is no effort to exactly duplicate all the pipe fittings, but the amount of pipe is there.

The instruction table is equipped with a No. 6 E. T. valve complete, with distributing valve working in tandem, also a G-6 engineer's valve which can be used with or without straight air. The above can be arranged for high pressure control or high speed brakes. The 9½-in. air pump can be driven by steam or air and can be operated direct or compounded for increasing the air pressure for high speed brakes. There is no boiler in the car, as it is intended to make steam and air connections from the pipe lines at the various shops or stations.

Beside the usual method of ventilation three hatchways are arranged along the roof of the car, having hinged covers which can be held securely open or shut by a screw adjuster. The office compartment contains two desks, bookcases, pull-out bed and two upper berths, besides clothes closets and wash basin. No accommodations for cooking are provided, as the car will always be located at points where hotel accommodations can be secured by those in charge. The car is lighted by Pintsch gas, and also wired for

electric lights. It is intended to make electrical connections, by flexible cables, to the circuits at the various shops.

The under-framing of the car consists of eight 5x8-in. sills, the side sills being reinforced by a 5/8x7-in. plate bolted to same. Four truss rods are used, two secured to sides of body bolster and the other two extending out to the end sills. The window posts are made solid so as to provide a good support for brake cylinder brackets.

Some of the principal dimensions are as follows: Length over end sills, 70 ft.; width over side sills, 9 ft. 8 in.; length of instruction room, 56 ft. 2 in.; length of office, 13 ft.; truck centers, 54 ft.; truck, type, 6-wheel, 5x9-in. journals; weight of car, 150,000 lbs.

Five for a Quarter.

A correspondent has sent us some interesting facts concerning the early life "adventures" of Mr. James Wares, the kindly and able shop manager for the Pullman Company at Chicago. In the letter "Supurb" says:

"Mr. Wares first saw the light of day in bonnie Scotland. When a mere lad he came to America. After the welcome and polish that Castle Garden ever extends and imparts to worthy visitors, he acted on the advice of Horace Greeley and went West to grow up with the country. St. Louis was his objective point. Arriving there he found his holdings of coin of the realm was but one solitary 25-cent piece. It was necessary to cross the city and he boarded a street car for that purpose. Passing up his quarter, he received in place of change four car tickets each good for a ride, but not legal tender for perishable food, and it is safe to say that however *short* he may have been on coin he was as *long* on appetite as any boy of his years in the whole city. However, he had "his smile" with him, which anyone versed in reading human nature would classify as a valuable asset. Fortunately at this point he met a fellow countryman to whom he frankly stated the situation. A square meal came first, and he admits even now that it was ahead of anything since produced in the culinary art; then came plans for a livelihood. Night schools supplied the needed education and a determination to win in the battle of life did the rest, till to-day among the captains of mechanical industry he occupies a position in the front rank."

AIR BRAKE INSTRUCTION CAR ON THE CENTRAL RAILROAD OF NEW JERSEY.

Safety in Freight Car Operation.

Mr. Edward A. Moseley, secretary of the Interstate Commerce Commission, when speaking on safety in freight car operation, contended that no unnecessary severity was exercised by the commission in enforcing the Safety Appliance Law. The commission has always discouraged the idea that the measure of an inspector's efficiency is the number of violations he may file against carriers.

Of the various defects constituting the basis of prosecution, inoperative uncoupling mechanism constitutes a large majority. There are 672 cases of this character. In 22 cases the chain had become kinked and wedged in the body of the coupler, thus rendering it impossible to lift the lock block. In 92 cases the lock block was either broken or missing. In 5 cases the chain connecting the lock block to the lever was too long, rendering it impossible to lift the lock block. In 76 cases the lever was missing. In 23 cases the lever was broken. In 433 cases the uncoupling chain was disconnected from the lock block, caused by broken links in chain, broken or missing clevis or missing clevis pins. There were 15 cases of link and pin coupler; 21 of inoperative driving wheel brakes on locomotives; 66 cases of failure to have the required percentage of air brakes; 2 broken couplers; 102 missing or insecure grab irons; 21 cases of draw bars either greater or less than the standard height, and 27 cases of cars without couplers fastened together with chains.

The most striking thing about these cases is that in many instances carriers have paid out hundreds of dollars in penalties which could have been entirely avoided by the expenditure of a few cents in labor and materials for repairs. One road paid $1,400 for defects that could have been repaired at a cost of $6.45; another paid $1,300 for defects that could have been repaired for $2.45; another paid $600 for defects that 80 cents would have fixed; another paid $300 which could have been avoided by the expenditure of 15 cents. In four typical cases, $4,900 would have been saved by the expenditure of $11.97; $4,200 by $8.43; $3,100 by $7.80, and $2,900 by $2.35. A total of 282 violations, involving fines amounting to $28,200, could have been avoided by the expenditure of $68.03, or an average cost, per violation, of 24 cents. These estimates have been made with considerable care from the scale of prices furnished by this association. They seem to indicate beyond any question of doubt that it is cheaper to repair safety appliances than to pay penalties.

Complaints continue to be numerous respecting the bad condition of hand brakes. With the rapid increase in the use of air the hand brake has been neglected, and I cannot too strongly urge that more attention be paid to its condition. The hand brake is called into use to a greater or less extent to insure the control of trains in cases of emergency and in special conditions of service. It is also necessary to use it when setting out cars along the road, and in switching movements, especially in gravity yards. Many employes have suffered serious injury in gravity yards because of defective hand brakes, and to this cause may be attributed much of the damage to cars and their contents which is commonly laid to rough usage or carelessness in switching. Our inspectors still find many hand brakes working opposite to the air brakes. This is extremely dangerous and it has been so repeatedly condemned that it is somewhat surprising to find such a condition existing in any degree at this time.

Complaint was made concerning want of uniformity in grab irons and other parts on which safety of trainmen depended. In many cases the practice seems to be to stick grab irons on any way, and it is not unusual to find grab irons applied differently on opposite ends of a car.

Applied Science Department

Elements of Physical Science.

XI. PNEUMATICS.

Pneumatics is the science that treats of air and other elastic fluids, their properties, and the machines in which they may be applied. The elastic fluids are such gases as retain their elastic form under ordinary conditions. It may be noted that some gases when submitted to high pressure assume a liquid form. Among these are carbonic acid and chlorine. Other gases, such as oxygen and nitrogen, cannot be changed to liquids by any known process. The vapors produced by heat from liquids and solids when cooled resume their liquid or solid form. The vapor arising from heated water is an example.

Air is the most common of the elastic fluids. It surrounds the earth to a distance of fifty miles from its surface. It enters the minutest pores of every object. It may be removed by the use of an air pump. Air is invisible, but it has all the essentials of matter and is impenetrable. It is readily compressible, and, according to Mariotte's law, a body of air which under a certain pressure occupies a cubic foot, under twice that pressure will be condensed into half a cubic foot, and so on in an exact ratio to the pressure. The elastic force increases with the density and also the weight, for while the compressed air remains invisible its weight increases in a ratio to the degree of compression. It may be added that air on the earth's surface is 815 times lighter than water, and has the quality of other elastic fluids in mutually repelling the particles composing it. The attraction of the earth holds the particles together or they would otherwise vanish into space. The attraction of the earth gives weight to the air, and this weight is known as atmospheric pressure.

This pressure is variable at different times and different places, and the barometer, an instrument invented about the middle of the seventeenth century, readily records the varying pressures. Air is rarefied by heat, and, being lighter than that which surrounds it, ascends till it reaches a region of equal density. The lowest parts of the atmosphere are the densest. In this the air resembles water, the density being greatest beneath on account of the greatest quantity from above. At sea level the pressure of the atmosphere approaches 15 pounds per square inch. The body of an ordinary-sized man is subjected to the enormous pressure of 30,000 pounds. The air within the body almost counterbalances the pressure and we are unconscious of the weight.

Compressed air has in recent years become of great service in the use of many mechanical contrivances, the most notable perhaps being in the use of the air brake where the air is compressed by fluid pressure into a receiver and released when it is desired to bring the train to a stop. The released air is applied to a series of movable pistons attached to levers that tighten the brake shoes on the locomotive and car wheels. Compressed air is also used in cranes, drills, rivetting machines and hammers, and many contrivances are now in use to which compressed air has been cleverly applied.

In tunnel excavations, especially under rivers, the use of compressed air has made possible many gigantic undertakings that otherwise could not have been successfully accomplished, the compressed air filling a compartment at the point of excavation and having the effect of preventing the falling of loose matter upon the workmen, and even preventing the outbreak of leaks of water that might otherwise flood the excavations.

Air pressure has also been turned to practical account for the transmission of mails. A strong metallic tube, perfectly smooth in the inside, is laid between two distant points, and a piston is tightly fitted to it. Large air pumps, worked by steam, are placed at the ends of the tube. The mail parcels being attached to the piston at one end of the line, the air pump at the other end is set in motion. A partial vacuum is produced and atmospheric pressure drives the piston through the tube with great velocity. Experiments have been made with atmospheric railways on the same principle, a train of cars outside of the tube being connected by an ingenious arrangement, with the air-tight piston propelled by the pressure of air rushing to fill the temporary vacuum.

Extremes of Heat and Cold.

It is difficult for an ordinary observer to appreciate the full significance of the variations of temperature in locomotive cylinders. It seems impossible that there could be much difference in the temperature of a cylinder whose piston is making two hundred strokes a minute, but the difference is frequently greater than that between a winter day with the thermometer standing at 30° below zero and a summer day with the thermometer at 80° above.

Heat and cold can be forced to great extremes by artificial means. Electrical furnaces produce as high a temperature as 5,000° Fahr., but there is no such extreme of cold. Physicists have calculated that the absolute zero of cold—that is the point where no heat exists—is 492 degrees below the freezing point of water. That temperature has never been reached, but some scientific experiments have come very near to it.

Prof. James Dewar reduced the temperature inside a small tube to within seven or eight degrees of absolute zero, and this stood as the record of human-made frostiness until the other day, when Prof. Karol Olszewski of the University of Krakau knocked off five or six more degrees. He was trying to liquefy the gas helium.

Upon suddenly expanding a mass of this gas, which had previously been compressed to 180 atmospheres (2,700 pounds per square inch) and cooled to the temperature at which hydrogen is at the liquefying point, the temperature fell to a point estimated at —271 degrees centigrade, or but two degrees above absolute zero. The helium, says Prof. Olszewski, showed no trace of interest in its own frigidity, and there was no indication whatever of liquefaction.

Radium Emanation.

The emanation or gas given off by Radium has aroused great interest, and has received considerable scientific attention. It possesses all the properties of a gas of the Argon family, but without chemical affinity; it is self-luminous, and follows Boyle's law; and it would appear to me monatomic, with an atomic weight of 160° and a density of about 80°. Its peculiar property of disappearing and reappearing does not seem to have been fully explained, but it has evidently some connection with its conversion into helium, the element originally found only in the sun. One hundred parts of the emanation change into 3½ parts of helium. The emanation has already proved serviceable in medicine. One-tenth of a milligramme

of radium bromide, injected hypodermically, gives rise to emanation in the tissues, and the consequent radio-activity has been found to check malignant growths. A simpler and perhaps less risky method of treatment is to coat celluloid plates and such like with a solution of radium, and to emply the radio-activity of the emanation thus generated by means of suitable appliances. A celluloid tube, for instance, may be coated inside with the solution, and by means of a rubber bellows the emanation may be blown into the lungs.

For use in medicine, thorium promises in great measure to take the place of radium, the prohibitive price and high potency of the latter being against its use. Thorium is comparatively cheap, and, though its radio-activity is slight as compared with radium, its cheapness allows of a sufficient quantity being used to obtain equal or nearly equal results. A number of thorium salts have been prepared for medicinal use.

Questions Answered

PARTS OF THE TRIPLE VALVE.

(12) L. C. B., of Covington, Ky., writes: What are the three (3) principal parts of a triple valve? —A. The triple valve piston, the slide valve and the graduating valve.

FEED VALVE OR BRAKE VALVE?

(13) L. C. B., of Covington, Ky., writes: With full pressure pumped up and both gauge hands showing the same pressure, how would you test to find if the trouble was in the feed valve or brake valve?—A. By noting whether the hands come up together on lap or in running position. If both hands come up together when the handle is on lap the brake valve is at fault. If the pressures equalize in running position only the feed valve is at fault, although both may be at fault in either case.

HISTORY OF THE BRICK ARCH.

(14) C. C., Two Harbors, Minn., asks: When and by whom was the first fire-brick arch invented? A little history of the brick arch will be duly appreciated. Please give dates if you can.—A. In dealing with the very question you have asked concerning the brick arch, Angus Sinclair, in his recently published book, "Development of the Locomotive Engine," says: "Previous to 1857 locomotives in New England used wood for fuel, and the price became so high that the roads must find a substitute or go out of business. The inventive workers of the country labored on producing smoke-preventing furnaces and boilers, but most of the products were worthless. George S. Griggs, with the perception of genius, conceived the idea of an appliance for obstructing the flame on its way to the tubes and produced the brick arch. Soft coal was tried on a locomotive 16x20-in. cylinders, 5½-ft. driver, and it was a success the first day. A shelf of cast iron was placed across the furnace under the tubes, and filled with firebricks; not being very durable an arch of firebricks 24x4x8 ins. was substituted. This was soon replaced by the brick arch as it is used today." Griggs was the master mechanic of the Boston & Providence. The arch was invented in 1857.

ADVANTAGE OF BALANCED VALVE.

(15) E. E. Rockhampton, Australia, writes: Would you kindly inform me what is the advantage of the balanced slide valves over the unbalanced type? I do not refer to piston valves.—A. This is simply a case of reducing friction, and reduced friction means less wear and tear and less lubrication, and, for that matter, a more even valve movement. Take, for an example, a slide valve 18 ins. long by 10 ins. wide. The area of this valve exposed to steam pressure is 180 sq. ins. Even a steam pressure of 100 lbs. per sq. in. would put a load of 18,000 lbs. on the valve as it moved backward and forward. If it was balanced to the extent of 50 per cent. the load would only be 9,000 lbs.

DRAWBAR PULL AND TRACTIVE EFFORT.

(16) G. A., Apalachicola, Fla., writes: Please explain in your paper the drawbar pull and how to calculate same; also the tractive power of a locomotive and how to calculate it.—A. We would refer you to the article on "Geared Engines Built at Lima," which appeared on page 36 of our January issue. The tractive effort formula is there explained, not only for the geared, but also for the ordinary locomotive. The drawbar pull is simply the tractive effort minus the internal friction of the engine itself. The amount of friction varies for several reasons in different engines. It may, however, be approximately stated at from 12 to 15 per cent.

AIR BRAKE PUMP GOVERNOR.

(17) G. A., of Apalachicola, Fla., writes: In the E. T. locomotive brake equipment, and the combined automatic and straight air locomotive brake equipment and the high speed and double pressure control apparatus, why is the excess pressure head added to the pump governor? Does not the minimum pressure head stop the pump when the pressure is sufficient?—A. As its name implies, the excess pressure head of the pump governor used with the E. T. brake equipment allows the pump to compress air in the main reservoir to a certain figure in excess of that used in the brake pipe regardless of what that pressure may be, while the brake valve handle is in running or driver brake holding positions.

You will note that the air pressure which is combined with the spring pressure above the diaphragm of this governor is taken from the feed valve pipe, which is controlled by the feed valve in release as well as running and holding positions of the brake valve.

The pressure below the diaphragm, which raises the pin valve from its seat and forces the governor piston down to close the steam valve when sufficient pressure is accumulated to overcome the combined air and spring pressure above the diaphragm, flows from the main reservoir through ports in the rotary valve and seat of the brake valve when the handle is in release, running and driver brake holding positions, and when on lap, service or emergency positions the rotary valve cuts off this flow and the maximum pressure head stops the pump.

With the schedule U or high-pressure control, or the duplex main reservoir control system, the low pressure governor top is operated with air taken from the feed port of the brake valve, or from the reversing cock, when the brake valve handle is in release or running positions. In the other positions the high main reservoir pressure is accumulated with which to promptly release the brakes and recharge the auxiliary reservoirs.

CYLINDERS ABOVE CENTER LINE OF DRIVERS.

(18) R. R. S., Chicago, writes: Some of the engines on the road where I work have the cylinder centers located above the center of the driving wheels. I am sufficiently familiar with physics to be aware that more useful effort can be exerted by a direct pull or thrust than by an angular effort. Why do the builders of locomotives not arrange for horizontal pulls and thrusts?—A. Cylinders are placed above the center of the driving wheels to keep them away from the road bed with its dirt and possible obstruction. The angularity of the power transmission amounts to very little.

DIAMETER OF CYLINDER AND STROKE.

(19) W. R. H., Sacramento, Cal., asks: In the same service which engine of similar power gives the best service, one with a comparatively long stroke and smaller diameter of cylinder or one of larger diameter and shorter stroke within reasonable limits of course.—A. This depends upon the class of service. Short stroke is good for light fast trains, and there is less counterbalance trouble. Long stroke is preferable for heavy trains, but much depends upon the diameter of the driving wheels. 1,000 to 1,100 ft. piston speed at 6c miles per hour is good practice.

LENGTH OF PORTS.

(20) W. R. H., Sacramento, Cal., writes: In further dealing with rules for correct steam distribution I find a great many devices for giving initial port opening, etc., such as the Allen valve and others, and

also find a rule that the length of the steam and exhaust ports should always be the length of the diameter of the cylinder or cylinders. And yet in locomotive practice this is very seldom done even on small cylinders. With but very few exceptions we find the steam ports from two to three inches shorter than the bore of the cylinder even on the smallest power. The longer port would not entail a larger valve, as the longer the port would be, it would be correspondingly narrower to give the same area. What mechanical variance from the rule causes this?—A. In proportioning ports it should be remembered that an extra long and narrow port is not so efficient as one that is somewhat shorter and wider, as the friction is greater, and the valve edge is more liable to get twisted and out of line if there is any cutting of one end of the face. Theoretical conditions frequently do not produce practical results, and much of the designing of locomotive parts has been based upon what has been found to satisfactorily meet various conditions. The conditions which may arise in practise cannot always be embodied in a set rule.

LENGTH OF CONNECTING ROD.

(21) W. R. H., Sacramento, Cal., asks: In an excessively high speed locomotive what tendency is there shown towards the length of the main rod, a long or short rod?—A. In high speed locomotives, the design of the engine controls the length of connecting rod, but it is not wise to make a very long rod; say 10 ft. or thereabouts, is good practice. Long rods are theoretically all right, but in practice, weight, stiffness, ability to stand alternate strains must be considered. Short rods are bad in various respects, and they introduce what is called "angularity," to a marked degree.

SIZE OF STEAM PORTS.

(22) W. R. H., Sacramento, Cal., writes: In studying valve design, I find among numerous rules one for finding port areas which is a fixed rule in all sizes. Now in comparing this rule with the way it is carried out in compound practice I find a great variance between the areas of the high and low-pressure ports of the compound entirely out of place with their respective sizes. Is it safe to say that the rule is followed in the high-pressure cylinder and exceeded also when a piston valve is used, but in the low-pressure cylinder about half the port area is used than is called for by a set rule? If the low-pressure cylinder will do good and correct work with this restricted port area, why will not a like restriction do as well in the high-pressure cylinder, especially in this age of exact science, to make the locomotive more efficient and economical? Is it safe to say that a great reduction in cylinder clearances could be made in the average locomotive if the same rule was worked as occurs in the low-pressure cylinder of the compound?—A. In studying port areas it must be remembered that the circular port of a piston valve is much less efficient for a given area than the straight port of a plain D-slide valve for two reasons: First, the port is divided by bridges which introduce friction, and second, the passageway round the valve bushing is generally very much restricted, so that the back portion of the port, opposite the passage to cylinder, is very inefficient. Large port areas militate against economy with trains well within the haulage power of the engine, as is common in England, and over there they therefore do not use large ports, and open them only about ¾ of their width for inlet of steam at full travel. In America, where it pays better to develop the greatest possible haulage at the sacrifice of some fuel, it is common to use larger ports, to insure free exhaust and the valve over-travels probably ¼ to ⅜ ins. at full travel, when admitting steam. Thus formerly, an 18 in. cylinder would have ports probably 16 ins. × 1⅛ ins., while later practice would give 17 ins. × 1½ ins. or more. In cross compound locomotives it is common to make the high pressure ports very large to increase the cylinder clearance, and thus reduce the compression, and for the same reason the inside of the valve is given clearance. The low-pressure ports are made large to enable the attenuated steam to get out, and this valve is also given clearance inside to provide time for exit of steam.

GUILLAUME NICKEL STEEL.

(23) Molder, Jersey City, writes: I have heard extraordinary claims made for Guillaume steel, but I never learned what it is good for. Is it a new form of self hardening tool steel?—A. We do not think Guillaume steel is used for tool making purposes It contains 36 per cent. of nickel and is noted for its low coefficient of expansion. This makes it eminently suitable material for pendulum rods and for other purposes where it is important to maintain an even length in extremes of temperature. It might be suitable for metallic packing, but would be expensive. It would be a valuable experiment to see Guillaume steel tried for gland packing and steam users might be willing to pay a high price if it proves efficient and durable.

ELECTRICITY FOR HOUSE-HEATING?

(24) R. Wilson, Cleveland, O., writes: During the cold weather of this winter I have ridden considerably on street cars that were heated by electricity, and they were kept very comfortable in spite of the doors having to be opened frequently. To me electricity is an ideal means of heating, and I consider that it ought to be introduced into all dwelling houses instead of the unsatisfactory stove, hot air furnaces or steam. Why is that not done? —A. Electricity is not used for house warming because direct heat or steam is much cheaper. When coal is burned in a steam boiler it is not uncommon for 60 per cent. of the heat in the fuel to be utilized for warming a house. When the heat of the coal is used to generate steam that will drive the machinery to produce electric energy and that again turned into heat, 10 per cent. of the original heat is seldom realized.

HEAVY "CLASS M" CONSOLIDATION ENGINES ON THE NORFOLK & WESTERN.

Procrastination has been called the thief of time. It is also the purloiner of opportunity, of wealth, and of all the comfort, ease, luxury, independence and varied gratification wealth affords. It is particularly ruinous to those who permit procrastination to interfere with punctuality in keeping engagements.

Heavy 2-8-0 for the D. & H.

The Schenectady works of the American Locomotive Company has recently completed an order of thirty consolidation locomotives for the Delaware & Hudson Company, which are particularly interesting as representing a departure from the usual design of locomotive with the Wootten type of firebox. This departure consists in placing the cab at the rear of the firebox instead of over the shell of the boiler, which is the ordinary practice.

D. & H. 2-8-0, WITH CENTRALLY PLACED CAB. SAME DESIGN AS NO. 1054.

This change in the position of the cab was first tried by the Delaware & Hudson Company in two of an order of fifteen ten-wheel locomotives recently built for them by the American Locomotive Company, and the change has proved such an advantage that the same practice was followed in the engines here illustrated. It necessitates an extension of the frame, thus somewhat increasing the overhang at the rear end, but this possible disadvantage seems to be more than offset by the advantage of having the engineer and fireman together in one cab. This is, however, not the first time that a cab has been placed at the back of the engine and over a wide firebox. In the February, 1907, issue of RAILWAY AND LOCOMOTIVE ENGINEERING, page 64, we illustrated a culm-burning locomotive on the Canadian Pacific Railway with rear cab where the engine crew were all together. The C. P. R. engine was built at the railway company's shops in Montreal.

Our illustrations show two D. & H. engines, and except for this change, which, as will be seen, greatly alters the appearance of the two machines, these engines are duplicates in design of a previous order executed for the Delaware & Hudson by the same builders, having a total weight of 246,500 lbs. The changes in the design, however, have increased the total weight of the thirty engines to 252,000 lbs. each, which makes these engines the heaviest of their type ever built by the American Locomotive Co. This added weight is, of course, all carried on the driving-wheels, thus increasing the adhesive weight to 223,000 lbs. instead of 217,500 lbs., as in the same design with cab ahead of the firebox.

DELAWARE & HUDSON SIMPLE CONSOLIDATION ENGINE.

J. H. Manning, Supt. of Motive Power. American Loco. Company, Builders.

These heavy 2-8-0 D. & H. engines have cylinders 23x30 ins. and 59 in. driving wheels. The tractive effort developed is 49,690 lbs., and with the adhesive weight as given above the ratio of tractive effort to weight on drivers is as 1 is to 4.4. The driving wheel base is 17 ft. and the total wheel base is 25 ft. 11 ins. The main valves are of the piston type, 14 ins. in diameter, actuated by Walschaerts gearing. These valves travel 5½ ins. in full throw and have 1 in. steam lap, while the edges of the valve inside are line and line. The lead is 3/16 in., which is of course constant.

The boiler is a straight top one 83¾ ins. in diameter at the smoke box end. The fuel is fine anthracite, which is burned in a wide or Wootten firebox, 126½ ins. long by 114 ins. wide, which gives a grate area of very nearly 100 sq. ft. It has in fact 99.85 sq. ft. The tubes in this boiler are 493 in number, 2 ins. outside diameter, and each 14 ft. 6 ins. long. This gives a tube heating surface of 3,716.6 sq. ft. and the arched crown ends and sides of the Wootten firebox gives 256.6 sq. ft. The total is therefore 3,973.2 sq. ft. The boiler pressure is 210 lbs.

The tender frame is made of 15 in. steel channels and the tank, which has a water bottom, holds 7,800 gallons and carries 14 tons of coal. The weight of the engine and tender in working order is about 403,100 lbs. The tender is equipped with the Shoen steel wheels, 33 ins. in diameter, and having 2½ in. rims. Some of the principal dimensions are as follows:

Wheel Base—Total, engine and tender, 59 ft. 9½ ins.

Axles—Driving journals, 10 x 12 ins.; engine truck journals, diameter, 6½ ins.; length, 12 ins.; tender truck journals, diameter, 5½ ins.; length, 10 ins.

Firebox—Thickness of crown, ⅜ in.; tube, 9/16 in.; sides, ⅜ in.; back, ⅜ in.; water space, front, 4 ins.; sides, 4 ins.; back, 4 ins.

Crown Staying—Radial.

Brake—Driver, Westinghouse and American combined on truck; Westinghouse Cross comp. pump; 2 reservoirs, 20½ x 102 ins.

Air Brake Department

Fifteenth Annual Convention.

The fifteenth annual convention of the Air Brake Association will be held at the Hotel Ryan, St. Paul, Minn., beginning at 9 A. M., Tuesday, June 9, 1908, and continuing three or four days.

The Accelerator Valve.

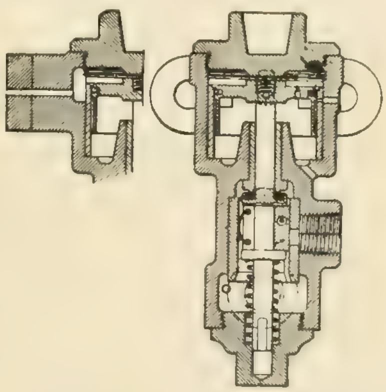
In our December issue appeared an illustration and description of the New York Automatic and Straight Air Brake for Locomotives, in which mention was made of the accelerator valve. As the name implies, the duty of the accelerator valve is to accelerate the reduction of brake pipe pressure in service applications of the brake. The accelerator valve reservoir receives a portion of brake pipe pressure in service applications corresponding to the volume of the brake pipe. The pressure from this reservoir enters on top of the accelerator valve piston and forces it downward a distance proportionate to the length of the brake pipe, which will in turn move the port in the slide valve down past the V-shaped port in its seat, thereby reducing pressure from the brake pipe in harmony with the brake valve through an opening in size according to the amount of reduction and length of brake pipe.

Cross-Compound Pump Troubles.

In a great many cases of the Westinghouse 8½-in. cross-compound pump stalling or working too slowly, insufficient lubrication is found to be the cause. While very frequently the lubricator feed may be sufficient the pump may not get the oil because of a leaky joint at the pump governor or some other leakage in the steam or oil pipe to the pump. The matter of lubrication no doubt receives proper attention with the 9½-in. pump, but even more attention and more oil should be given to the cross-compound pump. If the frictional resistance of main slide valve and differential pistons in the compound be increased by the want of oil until the steam pressure acting upon the differential pistons is unable to move the main slide valve, the pump will stall and even if it does not stall at once the wear upon the main slide valve will be heavy and it will probably cut the seat so that the pump will become very loggy in its operation and stall eventually. The surface to be lubricated in the compound pump is about three times greater than that of the 9½-in. pump. The lubrication of the compound pump is thus seen to be a matter of prime importance.

The S. F. pump governor, which is a part of the E. T. equipment and usually found with the compound pump, has an excess pressure head with a pipe connection from the feed valve pipe. Whatever amount of pressure the feed valve supplies enters this excess pressure head above the diaphragm, giving a pressure there equal to the tension of the excess pressure spring, plus the pressure supplied by the feed valve. If for any reason the feed valve should stick or become deranged in its operation it would cause the pump governor to stop the pump at a low pressure or be unreliable in its operation.

From this the importance of carefully maintaining the feed valve, as well as the pump governor, is readily seen. The maximum pressure head very rarely gives any trouble in the way of stopping the pump except in cases of pipe scale under the pin valve, which often happens with new locomotives.



SECTION OF ACCELERATOR VALVE.

There have been cases of the compound pump working slow enough when the steam pressure fell back to 145 or 150 lbs. to cause the brakes to creep on. Although it is possible for this to be the fault of the pump itself, by testing the steam and air gauge it is possible to find the trouble there.

The compound pump should work very well with a steam pressure of about 25 or 30 lbs. in excess of the main reservoir pressure, and where it does not there is a strong probability of the steam or air gauges are indicating incorrect pressures, tending to increase this difference.

For instance, suppose the air gauge to be indicating a main reservoir pressure of 130 lbs., when 140 lbs. existed in the main reservoir, and suppose the steam gauge indicated 150 lbs. when 140 lbs. was in the boiler. With a difference of about 30 lbs. the pump would only be compressing about 110 lbs. of air, which would be very likely to give trouble with the high speed brake in use.

If the top steam head gasket should leak steam across from the live steam passage into the high pressure steam cylinder it would drive the high and low pressure pistons on their respective strokes downward very fast, but would make the high pressure piston very slow on its upward stroke. This would have a tendency to make the pump loggy, especially with low steam pressure. The compound pump is new and we have much to learn about it. However, with proper care it is an excellent pump, and it needs care, like every other piece of mechanism from which we desire to get results.

Practical Air Brake Instruction.

A good air brake instructor is a profitable investment for any railroad company, and is worth many times the salary paid him in course of a year, while a poor one is not only a loss to the company as far as salary is concerned, but often he is a source of expense.

When an engineer is given air brake instruction it should be taken into consideration that the air brake is not the only part of the locomotive upon which improvements are made, and that he cannot give the brake his entire time for study. He also studies the time table, the bulletin board, and the road foreman of engines' instructions and a host of other things, and during air brake examination the instructor should bear this fact in mind.

Of what consequence is it whether the engineer knows or not which side of the packing leather should be placed to bear against the cylinder if he is never called upon to renew one, or of what benefit is it to him or to the company for him to know the sizes of the different parts of triple and brake valves, and when they are worn beyond the standard of the road if he never takes a valve apart.

It is of no practical value to him to know what degree of heat is generated in compressing air to different pressures, or how many cubic inches of compressed air the various reservoirs contain. Matters of this kind are all right for illustrations and for instruction if the engineer desires them, but it is unreasonable to insist upon them during examinations.

For practical purposes the engineer

should be instructed as to what to do in case of failure of any part of the apparatus, or in case of accidental breakage of any part while out on the road, and he should be instructed beforehand what can be done to get the train in motion in the shortest possible space of time, instead of waiting until he has made some mistake and detained a train, and then telling him what he should have done.

Another thing the engineer should know is how to report work that is necessary to keep the brake in good condition, and this should be insisted upon in the instruction car. Such reports in the engine house as "examine air pump," "examine brake valve," or "clean triple valve," reflect no credit on the kind of instruction that has been given or the way the lesson has been learned.

If the pump will not make enough air, stops, pounds or runs hot, or if the brake does not release promptly, does not apply, or if there is a "blow" at the triple valve exhaust port, it should be reported that way. The indefinite style of report, such as "The brake valve to be examined," simply causes loss of time. A statement should be made explaining how the brake acted on the road.

When the engineer reports any part of the brake to be examined, it is fair to assume that he does not know exactly what is wrong, therefore in the interests of all concerned he should state how it behaved, so that the repairman may locate the disorder and repair it as quickly as possible.

Work in many engine houses is not always done as it should be, and in many roundhouses there are no facilities for charging the brake system with air when the fire is drawn and there is no steam in the boiler. In cases of this kind the work that is reported may be done, and by the time the boiler is again under steam the engine is probably due to leave, and the repairman may find that he has "cleaned and examined" a triple valve when the packing leather in the cylinder is worn out, the piston travel is too long, or a bad leak exists in the air pipes. Under the circumstances the engine may leave with the brake in the same condition that it was upon arrival.

The engine is sometimes coupled to a train of unusual length, and the triple valve on the engine or tender may not release promptly and have to be bled off once or twice during the trip. Upon arrival at the engine house it may be reported for "cleaning." The repairman may clean it and the next man in charge of the engine may have it cleaned at some other engine house, and so on until the defective triple valve causes a detention and is removed from the engine. If the first engineer who had trouble with it had reported that the brake did not release when coupled to a long train, the triple valve might have been promptly removed and a good one put on. A somewhat unfortunate idea possesses some engineers about not reporting any air brake work. They explain all they know to the engine house foreman, who usually has troubles of his own, and, being human, proceeds at once to forget the air brake part of it.

It requires knowledge and experience to handle fast passenger trains safely and successfully, and a man's knowledge and efforts should not be misdirected. The engineer should know the construction and operation and the piping arrangement of the air brake equipment he is using, and the defects that the different valves may develop. If he knows this thoroughly he will give a good account of himself when in trouble on the road. He may have ideas of his own and handle trains safely under conditions that will surprise his superior officers. He can do all his without having had to study the full details of how each part is repaired in the shop. The main line of a modern railroad is no place to experiment with the air brake.

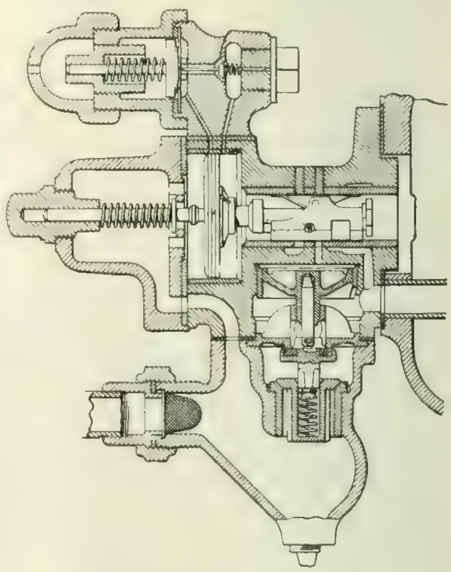
Sauvage Triple Valve Attachment.

A patent, No. 875,958, has recently been granted to Mr. William Sauvage of the Sauvage Safety Brake Company for an improved form of air brake triple valve, or rather an attachment to the ordinary triple valve, and in the patent specification we are told that "it is the object of this invention not only to provide effective means for automatically maintaining the pressure against reduction by leakage and for automatically recharging the auxiliary reservoirs to a predetermined pressure, but also to provide means for cutting off automatically the continued recharging, so that the necessary excess pressure can be exerted to throw the triple valve to release position."

A further object is to prevent the undesired release of the brakes through leakage at any point. In accordance with the invention, "provision is made whereby, when the triple valve piston is in lap position the train line pressure is admitted to the auxiliary reservoir to recharge the same through a device which can be controlled by the engineer to cut off the further recharging at any time and permit the triple valve to be thrown into release position, while at the same time, through another device, natural leakage from the brake cylinders is automatically compensated for and the unintentional release of the brake is thereby prevented. Moreover, the provisions for rapidly recharging the auxiliary reservoir under the control of the engineer renders the system practically a straight air brake system up to any predetermined pressure."

This device permits recharging the auxiliary reservoir without the use of retaining valves, and the pressure in the brake cylinders is not released and does not fall during the period of recharging, but is maintained at regular service pressure. A modification of the graduating valve is made for the purpose of maintaining the service pressure in the brake cylinder against leaks. Quoting again from the patent specification, "The engineer thus has complete control of all of the triple valves throughout the length of the train, when recharging the auxiliary reservoirs and holding the brakes on long descending grades, and the use of the ordinary retaining valves is rendered unnecessary.

"The slide block and graduating valve co-operate in the usual manner except that there is formed, either in the seat of the graduating valve or preferably in that portion of the graduating valve which co-operates with the seat, a channel, so that when the valve is on its seat and the transmission of working pressure to the brake cylinder is prevented, nevertheless there will be, through the channel a sufficient passage of air to compensate for



SAUVAGE TRIPLE ATTACHMENT.

the usual leakage in the brake cylinder, the channel being so proportioned as to permit the passage of air in proportion to the escape of air from the cylinder through leakage."

The British government are making coins of aluminum for use in Africa. The coins are intended to take the place of shells called cowries, which are used as currency in some parts of Africa.

Electrical Department

The Contactor and the Reverser.

By W. B. Kouwenhoven.

In our December, 1907, issue the General Electric type M, system of control, which is employed on the Manhattan Elevated Railway, was described. This type of control makes use of contactors for handling the heavy currents from the third rail and also uses the reverser for making the connections for forward or backward motion.

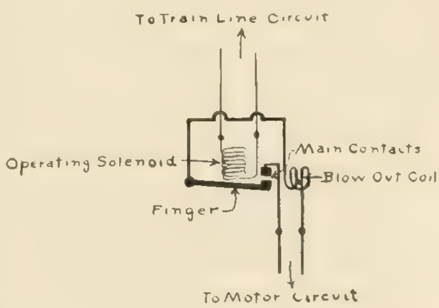
THE CONTACTORS.

The motors of a train like that to which we refer require very heavy currents, and it is not desirable to make the master controller drum large enough to handle them directly. Such a large and heavy controller drum as would be required would be not only difficult to operate, but it would take up too much space in the car. The drum, however, is only made large enough to carry the small current necessary to operate the contactors, which carry the large current for the motors. The small current can be readily handled by a small master controller drum, and the contactors can be placed underneath the car body where they do not occupy valuable space.

The contactor consists of four main parts, an electro-magnet or solenoid, a metallic finger, two main contacts, one fixed and one movable, and a magnetic blow out coil. The electro-magnet is energized through the train line circuits by means of the master controller which receives the electric power through two control rheostas or resistance coils. The magnet is made of a number of turns of wire about an iron core. Such an arrangement is called a solenoid. Solenoids of this type wer described in our January, 1907, issue.

When this solenoid is energized by the motorman having advanced his controller handle, the solenoid attracts the metallic finger against gravity and against the spring action of the finger. This finger is raised by the solenoid until it makes contact with the stationary or fixed main contact. The end of the finger which makes the connection is fitted with the other or movable main contact. The motors receive their heavy current through the connection made by these two contacts. When the solenoid is de-energized by the motorman shifting his controller handle to the off position, it (the solenoid) releases the finger, which falls back, due to the pull of gravity and the action of the spring. The separation of the two main contacts through which a large current was flowing to the motors tends to form a continuous spark or arc between them. If this arc were allowed to continue it would maintain the current supply to the motors and would soon destroy the two contacts. The magnetic blow out coil serves to extinguish this arc.

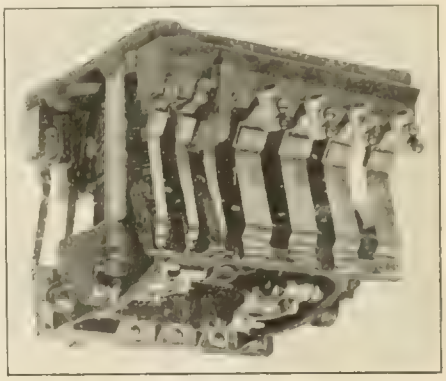
One of the phenomena of electricity is the effect produced upon an arc by a magnetic field. When placed at right angles to the arc the effect is to repel the arc. If the magnetic field produced by the magnet is very strong it will blow out the arc, thus extinguishing it. This fact is made use of in the magnetic blow-out coil. From the article on the solenoid in our January, 1907, issue, to which we have referred, it is clearly shown that not only does a steel bar-magnet possess a magnetic field, and



SKELETON CONTACTOR WIRING.

throws out lines of force, but if a coil of wire is traversed by a current it will also set up a magnetic field and throw out lines of force of its own.

The magnetic blow-out coil of the contactor consists of a soft iron core around which are wound a few turns of large wire which are connected in series with the circuit supplying current to the motors. These currents are large, and it only requires a few turns of wire to produce a very powerful magnetic field. The blow-out coil of the contactor is so arranged that its magnetic field is at right angles to the arc which will be formed upon opening of the main contacts. When the solenoid is de-energized and the finger drops, the arc then formed is immediately extinguished by the magnetic field of the



THE REVERSER.

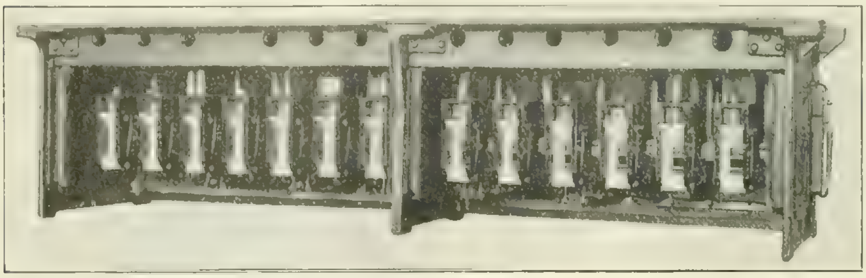
blow-out coil, thus preventing the damaging of the contacts and interrupting the current supply to the motors.

Briefly to go over the operation of the contactors, let us say, the motor man energizes the solenoid of the contactor by moving his master controller handle. The solenoid attracts the metallic finger and closes the two main contacts, thus feeding power to the motors. When the motorman interrupts the current supplied to the solenoid of the contactor, it de-energizes the solenoid and allows the finger to fall back. The opening of the contacts made forms an arc which is at once extinguished by the action of the magnetic blow-out coil, thus interrupting the current supply to the motors.

The reversing handle on the master controller drum does not change the connections from the go-ahead to the back-up position itself, but as in the case of the controller handle, it also depends upon a separate device to do its heavy work. This device is called the reverser, the movable parts of which are a rocker arm operated by two electro-magnets or solenoids working in opposition to each other. That is, one solenoid attracts the rocker arm in one direction and the other electro-magnet attracts it in the opposite direction.

These two electro-magnets are energized from the train line circuits by

means of the reversing handle mounted on the master controller drum. The connections to these two solenoids are so arranged with an interlocking device that only one of them can possibly be energized at a time. The controller drum is also fitted with an interlock, and this makes it impossible for any one to shift the reversing handle when the motors are receiving power. This prevents the accidental reversing of the direction of the current supply to the motors when the controller handle is in any other position than the off position.



CONTACTOR BOX AS PLACED UNDER THE CAR.

On both sides of the reverser are mounted seven fingers, four large heavy ones and three smaller ones. To these fingers are connected the wires leading from the fields and armatures of the motors. On both sides of the rocker arm there are contacts in the form of copper bars. These bars serve to make the proper connections with the fingers for the correct relations of the amatures and fields depending upon which direction the rocker arm is moved.

Besides the two operating solenoids of the reverser there are two magnetic blow-out coils, one on either side. These blow-out coils serve to extinguish any arcs that may be formed on the sides of the reverser between the fingers and the copper bar contacts of the rocker arm. This prevents the damaging of either the contacts or the fingers, and it makes the interruption of the current certain.

These two devices, the contactor and the reverser, not only keep down the size of the master controller drum and so act as space economizers, but their use makes it unnecessary for the master controller to deal with heavy currents, and this contributes to the safety of those concerned with its operation. Combined with the train line, they make it possible to operate any number of motor cars of the same type of equipment in one train, and all under the control of one motorman. They also serve to do the heavy work of the motorman in much the same manner as the pneumatic reversing gear of the Mallet steam locomotive does for the locomotive engineer.

"American" or 4-4-0 Electric.

The latest electric locomotive designed by the Westinghouse Electric & Manufacturing Company of Pittsburgh, Pa., is the first large high speed locomotive built for operating on a single-phase current exclusively, and it differs materially from any of the electric locomotives heretofore produced in that its running gear is modeled after that of the standard "American" or 4-4-0 type of locomotive, and thus many of the features of steam railroad practice have been incorporated. This locomotive was designed primarily to meet the conditions of service obtaining in the New York terminal of the Pennsylvania Railroad Company, which accounts for its name, "Pennsylvania No. 10003."

This locomotive was built for experimental purposes and may be said to be only one-half of a complete locomotive, but it has an electrical equipment complete in itself. The locomotive is intended to be coupled permanently back to back to a duplicate of itself, thus making a very large locomotive of the articulated type. It was considered that as the two half-units were exact duplicates, the general characteristic of the locomotive could be determined from a test of one-half. It was designed to operate on a line of voltage of 11,000 at a frequency of 15 cycles, and extensive tests of this locomotive made by the Westinghouse Company and the Pennsylvania Railroad during the past six months have shown very satisfactory results.

A complete locomotive of this type consisting of two units will weigh approximately 140 tons. The weight on each driving axle is 50,000 lbs., and on each truck 40,000 lbs. The complete locomotive can exert a continuous draw bar pull of 8,000 lbs., at a speed of 65 miles per hour, and it is capable of exerting a maximum starting draw bar pull of 40,000 lbs.

The general appearance and design of Pennsylvania No. 10,003 is shown in our illustration. The frame of the locomotive is of the rigid outside-bar type, consisting essentially of two cast-steel side frames joined at the ends by heavy cast-steel bumper girders and reinforced at three additional points by means of the truck bolster and two additional girders. It is very like an ordinary steam locomotive frame. The main journal boxes are carried in jaws which, like those of a steam locomotive, are fitted with wedges so placed to provide a rigid wheel base of 7 ft. 6 ins. The frame, however, is outside the wheels.

The cab is a superstructure of sheet steel with Z-bar ribs built on a 12-in. channel base frame. The cab floor is raised over the motors forming a rectangular box girder in the center of the cab. This raised deck or girder makes a convenient support for the control and auxiliary apparatus, and at the same time acts as a stiffenings backbone to the locomotive. This raised deck leaves considerable open space at the front of the locomotive where the motorman sits, and gives an ample passage-way round the other three sides of the cab. All of the auxiliary apparatus is on this raised deck. Each locomotive has two pairs of driving wheels 72 ins. in diameter. These wheels are made with cast steel centers and steel tires, the latter being secured in place by means of double Mansel rings. The truck is one of the regular four-wheel, swing bolster, locomotive type, having a wheel base of 6 ft. 2 in. and wheels 36 in. in diameter.

The weight of the motor frames and armatures is entirely spring supported, and almost all of the locomotive is above the springs. This carries the center of gravity to as great a height as possible with drivers of 72-in. in diameter. The height of the center of gravity of the weight which is carried on semi-elliptic springs is 5 ft. 10 in. above the top of the rails, and is 4 ft. 5½ in. for the entire weight of the locomotive.

Two Westinghouse single-phase 500 horse-power gearless motors are used, one being mounted on each driving axle. The motors are of the same type as those designed for the N. Y., N. H. & H.

In order to simplify the wiring and control circuits as much as possible, the two motors are connected permanently in series and are treated as one unit. When current is turned on both pair of wheels act very much as driving wheels do when coupled with side rods, only in this case each pair can slip separately. The motors are designed with air inlets and generous air ducts so that forced ventilation can be used efficiently. Air for this purpose is supplied by an electrically-operated fan blower in the cab and piped to the motors by means of a conduit and flexible connections. The continuous capacity of each motor under forced draught is 1,150 amperes at 275 volts.

The essential parts of the control system consist of one 11,000 volt transformer, two switch groups, three preventive coils, one master-controller, a small storage battery and the necessary wiring. The main transformer is placed across the locomotive directly over the rear wheels of the leading truck and extends up into the end of the raised deck in the cab. The main switch group, which consists of 15

electro-pneumatically operated switches, is directly over the transformer.

The general principle of operation of the control system is the same as that of all of the Westinghouse electro-pneumatic control equipments; that is, air cylinders are used to operate the various switches, and electro-magnetic valves control the supply of air to the various cylinders. A small storage battery of 10 cells is provided to operate the control magnets, and this battery is kept charged by means of a small motor-generator set in the locomotive. The master controller is placed in the front end of the cab. It has one operating and one reversing handle, and is arranged to give 12 running positions.

The brake equipment is a standard Westinghouse single-end type EL equipment. Air for the operation of the brake is supplied by one D-4-EG compressor operated by a single-phase motor The nominal capacity of the compressor is 45 cu. ft. of free air per minute. The current is collected from the trolley lines at 11,000 volts by means of a pneumatically-operated pantagraph trolley. This trolley is under control of the motorman at all times and may be raised or lowered by merely pushing a button located in the master controller. Connection is made from the trolley through an oil switch in the cab to the high tension lead of the main transformer. In recent tests this locomotive has attained a speed of 88 miles per hour with entirely satisfactory results.

ELECTRIC LOCOMOTIVE WITH FRAME LIKE THAT OF A STEAM LOCOMOTIVE. HIGH CENTRE OF GRAVITY.

All good ends can be worked out by good means. Those that cannot are bad, and may be counted so at once and left alone.—*Barnaby Rudge.*

Eminent Engineers.

V. DENIS PAPIN.

Coincident with the experiments of Thomas Savery in England is the work of Denis Papin of France. The first vision we get of this interesting character is in 1674, when he came to Paris and settled as a practising physician in that city. He conducted experiments with the air pump and wrote a series of papers which were published in the *Philosophical Transactions* of 1675. He visited London and afterwards accepted a position in the Academy of Venice, where he remained ten years. He conducted a series of important experiments in raising water by machines driven by the current. He removed to Cassell, and here he perfected a machine for raising water by the force of steam. He also constructed a carriage to be propelled by the same means. In 1702 he invented a steam engine for throwing stones, which he claimed would make a lasting peace with France. This engine was used in several European wars, and surpassed in force and weight of projectile the artillery of that period. It was a terrifying machine, but failed to bring about the promised peace.

The Elector of Cassel took a lively interest in Papin's experiments, and it seems remarkable that having succeeded in demonstrating the power of steam in raising water to a height of over seventy feet and also in moving carriages on public highways there is no evidence of any of his machines coming into general and lasting use. Of the steam engine of to-day the only part that might be properly attributed to Papin is the safety valve. In common with the Marquis of Worcester and Captain Savery, Doctor Papin seems to have worked in advance of time. The feeling against new machines seems to have been crystallized in the public mind, and unless under royal patronage nothing could be attempted. Such patronage was usually of a whimsical or spasmodic kind. In the case of the Elector of Cassel, as soon as Papin had perfected his steam engine for pumping water the vainglorious Elector claimed the invention himself, and Papin was compelled to look for other patronage.

In 1707 he sailed for London in a boat propelled by paddle wheels. On the river Weser he was set upon by the river boatmen, who objected to any kind of invasion of their privileges in the navigation of that river. His family and crew were subjected to many privations and on his arriving at London he found himself friendless.

In his time he was furnished with great facilities for experimental work, and also with ample means, and his operations were regarded with great interest, but it seemed as if the world was not in need of the titanic powers which he dimly illustrated. The mass of humanity were content to live as their ancestors had lived, and while there were a few eminent engineers who could appreciate the value of the work of Savery and Papin, many years had to elapse before their ingenious labors could blossom into accomplishment.

Murphy Method of Instruction.

By Prof. F. Paul Anderson,
Dean of the Mechanical Engineering Dept. of Kentucky State College, Lexington, Ky.

While at Lexington, Ky., as Superintendent of the Cincinnati Division of

FIG. 1. LEADING CAR OF TRAIN WHEN BEING PUSHED AT NIGHT.

the Cincinnati Southern, in 1896, Mr. W. J. Murphy, now Vice-President of the Cincinnati, New Orleans & Texas Pacific Railroad and the Alabama Great Southern, devised the most efficient method that has ever been introduced, for examining and instructing railroad employees.

From the Book of Rules, the railway employee is able to secure only a partial knowledge of the meaning of all the rules of procedure in the handling

FIG. 3. MARKER FLAGS ON REAR OF TRAIN.

of trains. A large percentage of railway employees are not able to comprehend fully the meaning of terse and concise English, and an object lesson in the presentation of actual cases that may arise in daily practice is the only thorough and comprehensive way for training every employee up to the highest efficiency in train rule knowledge.

It is not at all satisfactory for employees to have a mere general impression, relative to the meaning of rules. There must be a uniformity of knowledge in order that trains may be handled safely, and with the least possible loss of time. Mr. Murphy was one of the first railroad men in the country to take the stand that modern railroading is a science, and therefore the training of men should be dealt with in a scientific manner.

On account of his long experience in the training of railroad men, Mr. Murphy came to the conclusion that the ordinary methods of questioning trainmen on the Book of Rules was inefficient; and frequently employees would recite, verbatim, the rules, and it would be determined later that they had nothing of a definite conception of the meaning of the same.

It is impossible to spend the time necessary to take trainmen to various points on the line, and question them on the meaning of signals in certain positions or the meaning of the lamp and flag code, when certain combinations appeared. This would be the ideal system, but it is not practicable. He concluded that the only other method to be employed in instructing or examining trainmen was a process practically identical with the actual display of signals, whether they be electric or block signals, lamps or flags.

The system of instruction which is known throughout the railroad world as the "Murphy Method" was devised with this end in view. He was the first one to put into practice the use of the stereopticon, in presenting to railway employees, by means of lantern slides, the various positions and colors of signals so that trainmen can be questioned as definitely in the presence of such pictures, as they could be if they were looking at the actual track and equipment.

Railway companies throughout the country were slow to take up this innovation in the method of better informing their employees; but during the last two or three years a great many of the prominent railroad systems have adopted the "Murphy Method." Mr. Murphy has published, from year to year, a text book called the "Stereopticon Method of Examining and Instructing Railway Employees," and this book is revised as necessary to take into account any important changes that are made in the Book of Rules.

The last road to adopt the "Murphy Method" is the Union Pacific, and this railroad has fitted up a large car for the training of employees who have had to do with the handling of trains. This car is supplied with a stereopticon, and a number of lantern slides, which will bring to the attention of the trainmen, who are being examined or instructed, the actual condition of signals in their relation to equipment, as they appear in practice.

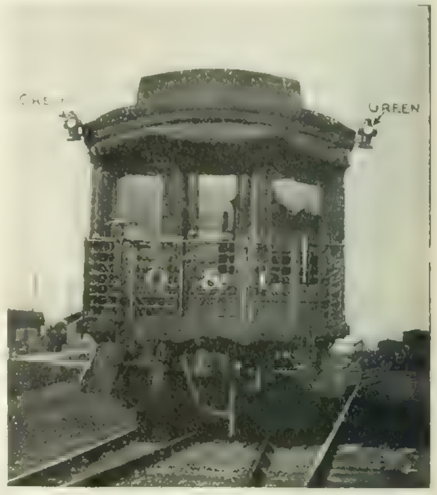


FIG. 2. MARKER LIGHTS, GREEN TO REAR WHEN ON SIDING TO BE PASSED BY TRAIN RUNNING IN SAME DIRECTION.

The "Murphy Method" has been the means of decreasing the percentage of accidents on our railroads, caused by improper interpretation of orders, expressed to the employees, by means of the signals in certain positions. In railroad operation it is impossible to avoid accidents that occur, due to the giving way of equipment. But Mr. Murphy has always contended that accidents due

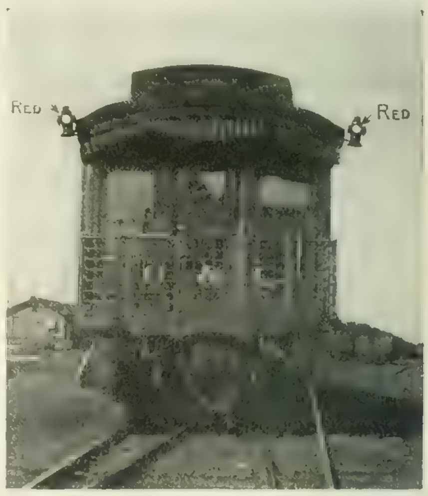


FIG. 4. MARKER LIGHTS, RED TO REAR ON MAIN LINE.

to lack of understanding of signals, should be practically eliminated from our railroad practice.

While the author of this method of instruction was superintendent of the Cincinnati division of the road, a rigid system of examination was enforced,

and the influence of the training received at that time has been an important element in bringing the Cincinnati Southern men up to their well known standard of efficiency.

The move that has been made on the

FIG. 5. OBLIQUE POSITION OF SEMAPHORE BLADE, BLOCK IS CLEAR.

part of that great system, the Union Pacific, is a tribute to the genius of Mr. Murphy, who produced the method of educating railway employees in such a manner as to insure a speedier, surer and safer practice in the handling of trains on our American roads.

Railroad operation is one of the most progressive sciences of the day. The successful operation of a railroad, however, is entirely dependent upon a thorough education of the employees in all the necessary requirements of the rules laid down for their guidance, thereby enabling them to intelligently and successfully apply them in practice. A thorough knowledge of the signals is of vital importance. In fact, it is equally as essential as it is that they read and write the English language; for upon a thorough knowledge and a strict compliance with the language indicated by the different signals depend the safety of both lives and property.

In order to understand more comprehensively the use of the stereopticon method, a few examples are here given.

Fig. 1.—White light on rear of coach is shown on screen.

Q. What does the signal on this train indicate?

A. Indicates that the train is being pushed by night; the rules require there shall be a white light on the leading car when a train is pushed.

Figs. 2 and 3.—The passenger train with markers (lights) turned with green to the rear is shown on the screen.

Q. Why are the markers in this position?

A. The rules require that the red lights should be removed and green displayed when a train turns out to be passed by another train running in the same direction, but the red must be again displayed before returning to the main track.

Fig. 4.—The rear of a train carrying markers showing green to front and side, red to rear.

Q. What are the classification signals?

A. Signals placed on the front of an engine to indicate whether a train is an extra or is followed by another train running on same schedule and entitled to the same rights.

Q. What are markers?

A. Two green flags or green lights displayed on the rear car, or on an engine if it be in rear of a car, to indicate that the train is complete.

Q. In addition to the classification signals and markers, what signals must be displayed on the front and rear of each train, running after sunset, or when obscured by fog or other causes?

A. A headlight on front and two or more red lights on the rear.

FIG. 6. SIGNAL ARM HORIZONTAL, BLOCK OCCUPIED; STOP.

Q. What do the signals on this train indicate?

A. Indicate that it is a section of a regular train, and is followed by another section on the same schedule and having the same rights. The markers on the rear indicate that the section is complete.

Figs. 5 and 6.—Electric Semaphore Block Signals on single track.

Q. What does the signal indicate in its present oblique position? (Fig. 5.).

A. Indicates that block is clear.

Q. How is this position indicated at night?

A. By white light.

Q. If signal is in this position (horizontal), what does it indicate? (Fig. 6.)

A. That the block is occupied.

Q. How is this position indicated at night?

A. By a red light.

Q. How would you be governed approaching the block in the position indicated (horizontal)?

A. Stop the train before entering the block, send a flagman ahead with danger signals immediately; wait five minutes after the flagman had started and follow him through the block, not exceeding six miles an hour.

Q. Describe how the signal indicates that the block is clear and that trains may proceed.

A. The signal must be in the oblique position when the train enters the block and change to horizontal before the train reaches the signal. Trains may then proceed at their usual speed through the block.

Q. Are there any circumstances under which a train may pass the home signal when horizontal without sending a flag ahead? Quote the rule.

A. In approaching a meeting point within the limits of a block, the train of inferior right will not flag.

Fig. 7.—Electric Disc Block signals on single track. Same rules apply. Color takes place of position of the signal arm.

Q. What does the signal indicate in its present (top arm horizontal, lower arm oblique) position? (Figure 8.)

A. Improperly displayed signal—indicating signal is out of order.

Q. How is this position indicated at night?

A. By two lights, red over white.

Q. How would you be governed approaching the block in this position?

A. Stop before entering the block, wait one minute and proceed under control.

FIG. 7. BLOCK SIGNAL DISC. COLOR TAKES PLACE OF POSITION

Q. What does the signal indicate in its present (top arm oblique, lower arm horizontal) position? (Fig. 9.).

A. Indicates the first block in ad-

vance is clear, and the second block in advance occupied.

Q. How is this position indicated at night?

A. By two lights, white over green.

Q. How would you be governed approaching the block in this position?

A. Reduce speed and be prepared to stop at next block.

FIG. 8. RIGHT-HAND TRACK, SIGNALS OUT OF ORDER. SOMETHING WRONG—STOP.

FIG. 9. RIGHT-HAND TRACK, FIRST BLOCK IN ADVANCE CLEAR, SECOND OCCUPIED—PROCEED CAUTIOUSLY.

Q. What does the signal indicate in its present (both arms horizontal) position? (Fig. 10.)

A. Indicates both blocks next in advance are occupied.

Q. How is this position indicated at night?

A. By two lights, red over green.

Q. How would you be governed approaching the block in this position?

A. Stop before entering the block, wait one minute and proceed under control.

FIG. 10. RIGHT-HAND TRACK; BOTH BLOCKS IN ADVANCE OCCUPIED—STOP.

FIG. 11. RIGHT-HAND TRACK, TWO BLOCKS IN ADVANCE CLEAR—PROCEED.

Q. What does the signal indicate in its present (both arms oblique) position? (Fig. 11.)

A. Both blocks next in advance clear.

Q. How is this question indicated at night?

A. By two lights, white over white.

Q. How would you be governed approaching the block in this position?

A. Maintain schedule speed.

The foregoing illustrations present only a few of the applications of the use of the stereopticon in connection with the Book of Rules. When the method is employed in a suitable lecture room, with first-class lantern slides, beautifully colored, the impression made on the mind of the trainman is even more definite than could be created by the actual presentation of the real signals and appliances.

The "Murphy Method" is presented in book form which has been copyrighted, and each road may secure permission to use lantern slides applicable to local conditions, in connection with the book.

The instruction book has been put up in small, compact form, so that it is easily carried in the pocket for use during spare moments, that come into the life of every man.

Telegraphing by Touch.

The newspapers of New England have been lionizing Peter A. Foley, of Portland, Me., as the most wonderful telegraph operator in the world. They say that Foley is totally deaf, an affliction which ordinarily would be supposed to make telegraphy an utter impossibility to him, but since he became deaf, eight years ago, he has developed what may be called a sixth sense, and by touch and sight he can detect the finest movements of the instrument and correctly interpret them. By means of the sense of touch in his finger tips he takes messages transmitted from the ends of the continent and can also read a message by watching the sounder. With his left forefinger placed lightly on the sounder he can take a message as accurately as the average operator.

This may seem extraordinary to the average newspaper reporter, but telegraph operators see nothing in it worthy of comment. It is a very poor operator who cannot receive by the touch. A bad row happened once when two operators were in a card game and by touching the feet told contents of each other hands. A young man and a young woman were once traveling in a Pullman car. Both were telegraph operators and they began courting and telling stories by touching hands. They laughed occasionally and the other passengers became amazed at the origin of the mirth and evident intercourse as they acted like deaf mutes without finger signs. They sat together, hands out of sight, so that nothing was seen. It was a pair of operators out on their honeymoon.

Items of Personal Interest

Mr. J. G. Crawford has been appointed fuel engineer of the Chicago, Burlington & Quincy, with headquarters at Chicago, Ill.

Mr. J. B. Hasty has been appointed division foreman of the Atchison, Topeka & Santa Fe, with headquarters at Shawnee, Okla.

Mr. H. Rhoads has been appointed general foreman of the Princeton shops of the Southern Railway, with office at Princeton, Ind.

Mr. Wm. Nix has been appointed round house foreman of the Atchison, Topeka & Santa Fe Railroad, with office at Arkansas City, Kan.

Mr. J. P. McCuen, superintendent of motive power of the Cincinnati, New Orleans & Texas Pacific, at Ludlow, Ky., has resigned.

The position of general master mechanic on the International & Great Northern, until recently held by Mr. George S. Hunter, at Palestine, Texas, has been abolished.

Mr. M. Flanagan has been appointed division master mechanic of the Great Northern, at Harve, Mont., vice Mr. K. A. Froberg, transferred.

Mr. J. F. Enright has been appointed superintendent of motive power of the International & Great Northern Railway, with office at Palestine, Tex.

Mr. E. E. Machovee has been appointed general foreman of shops of the Atchison, Topeka & Santa Fe Railway, with headquarters at Newton, Kans.

Mr. L. N. Bassett has been appointed superintendent of terminals of the St. Louis & San Francisco Railroad, with headquarters at Springfield, Mo.

Mr. J. G. McLaren has been appointed master mechanic of the Chicago, Rock Island and El Paso Railroad, with office at Dalhart, Tex.

Mr. H. Muir has been appointed road foreman of engines and general foreman of the Louisville division of the Southern Railway, vice Mr. Rhoads, transferred.

Mr. G. F. Moore, formerly traffic manager of the St. Joseph Valley Railway Company, has been appointed general manager, with offices at Lagrange, Ind.

Mr. N. N. Boyden, formerly master mechanic on the Southern Railway at Birmingham, Ala., has been appointed master mechanic on the same road at Atlanta.

Mr. G. Armstrong, formerly car shop foreman, has been appointed general car shop foreman on the Canadian Pacific Railway, with headquarters at Winnipeg.

Dr. W. F. M. Goss Honored.

The formal exercises incident to the installation of Dr. W. F. M. Goss as Dean of the College of Engineering of the University of Illinois occurred February 5 in connection with the formal opening of the graduate school of the university. The exercises of installation included two sessions and a tour of inspection through the laboratories of the College of Engineering.

The programme for the morning session began with a brief address by the president of the university, Dr. Edmund J. James, introducing the chairman of the session, Professor James M. White. Professor Ira O. Baker, who for more than thirty years has been identified with the College of Engineering, described some significant events in the development of the college, giving special emphasis to the work of Stillman W. Robinson, the first professor in the College of Engineering of the University of Illinois, who continued in its service for a period of seven years. Mr. William L. Abbott, president of the board of trustees and a graduate of the College of Engineering, discussed briefly the standing of the technical graduate in the engineering profession. Following this a formal installation address, entitled "The State College of Engineering" was delivered by Dean W. F. M. Goss. This session was made memorable by the presentation of a token of their esteem by his associates in the College of Engineering to Dr. N. Clifford Ricker, a member of the class of 1872, the first professor of architecture, for thirty-five years a member of the instructional staff of the University of Illinois, and for the most of this period dean of the College of Engineering. Letters were read expressing interest in the occasion from Dr. Andrew S. Draper, president of the University of Illinois from 1894 to 1904; from Professor Stillman W. Robinson, the first professor of mechanical engineering, now a resident of Columbus, Ohio, and from Professor J. Burkitt Webb, the professor of civil engineering, later of Stevens Institute of Technology.

DR. W. F. M. GOSS.

The afternoon session included an address by Mr. Robert W. Hunt of Chicago on "The Value of Engineering Research," and an address by Mr. Willard A. Smith of Chicago on "The Need of Graduate Courses in Engineering."

Mr. G. Akans, formerly master mechanic of the Southern Railway at Selma, Ala., has been transferred as master mechanic on the same road at Birmingham, Ala.

Mr. C. H. Fisk has been appointed chief engineer of maintenance of way of the Colorado Southern, New Orleans & Pacific Railway, with office at Beaumont, Tex.

Mr. W. E. New has been appointed master mechanic of the Kansas City Belt Railway, with headquarters at Kansas City, Mo., vice Mr. G. T. Neubert, resigned.

Mr. Wm. Jackson has been appointed superintendent of signals on the Rome, Watertown & Ogdensburg division of the New York Central, succeeding Mr. A. E. Eckert.

Mr. J. McCabe, formerly engine foreman at the Harlem River Terminal, has been appointed general road foreman of engines on the New York, New Haven & Hartford, with headquarters at New Haven, Conn.

Mr. Frank Peyton has been appointed road foreman of engines of the Oklahoma division of the Atchison, Topeka & Santa Fe Railway, with headquarters at Kansas City, Ark.

Mr. Chas. A. Kimmell has been appointed division foreman of the Missouri Pacific and St. Louis, Iron Mountain & Southern Railways, with headquarters at Greenleaf, Kan.

Mr. J. H. Talty, road foreman of engines on the Lackawanna, at Buffalo, N. Y., was elected third vice-president of the Central Railroad Club at the last annual meeting.

Mr. W. Kennedy has been appointed superintendent of motive power and cars of the Central of Vermont Railway, with office at St. Albans, Vt., vice Mr. James Coleman, resigned.

Mr. E. W. Tucker, formerly round house foreman of the Atchison, Topeka & Santa Fe at Arkansas City, Kan., has been appointed round house foreman on the same road at Newton, Kan.

Mr. C. A. Emerson, formerly traveling engineer on the Lake Superior division of the Northern Pacific, has been appointed general foreman of the Minnesota & International Railway.

Mr. R. F. McKenna, master car builder of the Delaware, Lackawanna & Western, at Scranton, Pa., was recently elected president of the Central Railroad Club for the year 1908.

Mr. E. F. Kearney has been appointed superintendent of transportation on the Missouri Pacific Railway, with headquarters at St. Louis, Mo., vice Mr. T. E. Byrnes, resigned.

Mr. A. E. Walton, division superintendent on the New York Central, has been appointed to a similar position on the same road at their West Albany shops, vice Mr. G. H. Haselton, promoted.

Mr. E. B. Brown has been appointed superintendent of bridges and buildings of the St. Louis & San Francisco Railroad, with headquarters at Beaumont, Tex., vice Mr. H. M. Henson, resigned.

Mr. J. R. McMullin has been appointed master mechanic of the Cananea Consolidated Copper Company's Railway with headquarters at Cananea, Son., Mex., vice Mr. Weitzel, resigned.

Mr. Silas Zwight, formerly road foreman of engines on the Northern Pacific, has been appointed master mechanic of the St. Paul division, on the same road, with headquarters at Minneapolis, Minn.

Mr. W. T. Ingram, formerly engineer of maintenance of way on the Interoceanic, has been appointed superintendent of permanent way, of the Mexican Railway, with headquarters at Mexico, Mex.

Mr. I. M. Newman has been appointed president of the following companies, with offices at Williamsport, Pa.: The Susquehanna & New York Railroad, the Tonesta Valley Railway and the Leetonia Railway.

Mr. J. T. Lendrum, formerly general foreman on the Atchison, Topeka & Santa Fe at Arkansas City, Kan., has been appointed master mechanic of the Oklahoma division, with headquarters at Arkansas City, Kan.

Mr. Charles E. Fuller, formerly superintendent of motive power of the Chicago & Alton, has been appointed assistant superintendent of motive power of the Union Pacific Railway, with offices at Omaha, Neb.

Mr. J. F. Whiteford, formerly general round house inspector on the Atchison, Topeka & Santa Fe, has been appointed bonus supervisor of the Coast Lines of the same road, with headquarters at San Bernardino, Cal.

Mr. C. T. Hessmer, formerly road foreman of engines of the Northern Pacific at St.. Paul, Minn., has been appointed master mechanic of the Minnesota division at Staples, Minn., vice Mr. W. Lincoln, resigned.

Mr. J. L. Sydnor, formerly bonus supervisor of the Atchison, Topeka & Santa Fe Coast Lines, has been transferred as bonus supervisor of the Eastern Grand Division, vice Mr. E. E. Arison, assigned to other duties.

Mr. A. Dinan, formerly master mechanic of the Middle Division of the Atchison, Topeka & Santa Fe, has been appointed master mechanic of the Missouri division of the same road, with office at Ft. Madison, Ia.

Mr. F. L. Woodwine has been appointed road foreman of engines of the Pocahontas Division of the Norfolk & Western Railway, with headquarters at Bleufield, Wyo., vice Mr. D. E. Gardner, transferred.

Mr. G. W. Taylor, formerly master mechanic of the Oklahoma division of the Atchison, Topeka & Santa Fe, has been transferred to Newton, Kan., as master mechanic of the Middle Division, vice Mr. Dinan, promoted.

Mr. H. W. Jacobs, the present assistant superintendent of motive power of the Atchison, Topeka & Santa Fe, retains the same title with duties enlarged, having jurisdiction of all betterment work, shops, tools and machinery.

Mr. W. F. Buck, formerly mechanical superintendent of the Eastern Grand Division of the Atchison, Topeka & Santa Fe, has been appointed superintendent of motive power of the system, with headquarters at Chicago, Ill.

Mr. O. G. Cheatham, formerly master mechanic on the Seaboard Air Line Railway at Jacksonville, Fla., has been appointed general foreman of shops of the Southern Railway, with headquarters at Jacksonville, Fla.

Mr. J. H. McGoff, formerly master mechanic of the Missouri division of the Atchison, Topeka & Santa Fe, has been appointed mechanical superintendent of the Eastern Grand Division of the same road, with headquarters at Topeka, Kan.

Mr. W. G. Hodgson, formerly general car foreman of the Canadian Pacific Railway at Winnipeg, Man., has been appointed district car foreman of the Pacific division on that road, with office at Vancouver, B. C., vice Mr. Pickern, deceased.

Mr. J. L. Butler, formerly general foreman of the Sedalia shops of the Missouri Pacific and St. Louis, Iron Mountain & Southern Railways, has been appointed master mechanic on those roads, with office at Atchison, Kan., vice Mr. L. J. Miller, resigned.

Mr. John A. Turtle, formerly assistant superintendent of motive power of the Union Pacific Railway, has been appointed master mechanic of the Colorado Division of that road, with headquarters at Denver, Col., vice Mr. E. F. Fay, transferred.

Mr. Raymond D. Carter, formerly managing editor of the Newark *Morning Star*, has been appointed general advertising agent of the Central Railroad of New Jersey and editor of its monthly magazine, *The Suburbanite*, with offices at 143 Liberty street, New York.

Mr. J. C. Stone, formerly round house foreman for the New Orleans & Northwestern Railroad at Ferriday, La., has been appointed foreman of the White River division of the Missouri Pacific Railway, with headquarters at Cotter, Ark., vice Mr. W. R. Bruner, resigned.

Mr. H. P. Latta, formerly superintendent of motive power on the Mobile, Jackson & Kansas City Railroad at Mobile, Ala., has been appointed master mechanic of the Seaboard Air Line Railway, with headquarters at Jacksonville, Fla., vice Mr. O. G. Cheatham, resigned.

Mr. E. G. Brooks has been appointed master mechanic of the Mobile division of the Mobile & Ohio Railroad at Whistler, Ala., vice Mr. J. F. Enright, resigned, to accept position with the International & Great Northern. Mr. Brooks also holds the title of master mechanic of the Southern Railway in Mississippi.

Mr. H. Weitzel, master mechanic of the Cananea Consolidated Copper Company's railway at Cananea has resigned to accept a position as general foreman at the Guaymas shops of the Sonora Railway. Upon leaving he was presented with a gold watch by the employees of the copper company.

Mr. James McDonough has been appointed general foreman on the Trinity & Brazos Valley Railway at Galveston, Tex. The company are building very extensive terminals at that point and also at Houston, Tex. Mr. McDonough is an old friend of RAILWAY AND LOCOMOTIVE ENGINEERING and has been a valued contributor to our columns.

At the annual meeting of the directors of the Frost Railway Supply Company, recently held in Detroit, the officers elected for the ensuing year were: President, Mr. Harry W. Frost; vice president, Mr. George A. Cooper; treasurer, Mr. Frederick H. Holt; secretary, Mr. James Whittemore; assistant secretary, Mr. Harry C. Smith.

Doctor of Engineering.

The following letter recently received explains itself:

Purdue University, Lafayette, Ind.
February 4th, 1908.

Mr. Angus Sinclair,
Editor of Railway and Locomotive Engineering,
136 Liberty Street, New York, N. Y.

Dear Sir—I have the honor to inform you that the Faculty of Purdue University, at a recent meeting, voted unanimously to recommend your name to the Board of Trustees of the University as the recipient of the honorary degree of "Doctor of Engineering" at the next commencement.

In taking this action the Faculty desires to give expression to the high esteem in which you are held by your large circle of friends, and feels that it will be an honor to the University to be connected with you in this way.

It is customary upon occasions of this kind for the recipient of the degree to attend the commencement exercises. They will be held this year on Wednesday morning, June tenth, and I trust we may have the great pleasure of your presence at that time.

With many assurances of esteem, I am, Yours very truly,
(Signed) W. E. Stone,
President.

Obituary.

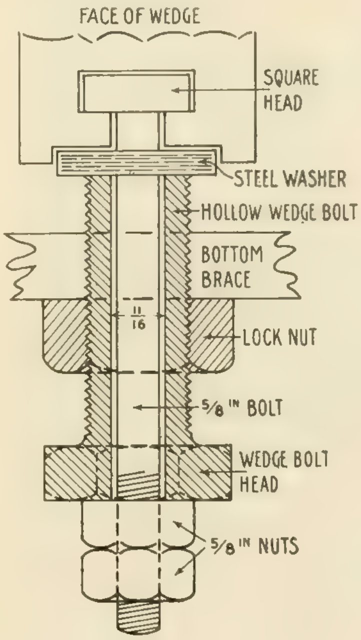
It is with deep regret that we have to record the death of a valued member of the staff of the National Acme Manufacturing Company of Cleveland, Ohio. Orrin S. Werntz, treasurer of the company since its organization, died at his home on February 6, 1908, at the age of thirty-two. He was born in Canal Fulton, Ohio, but removed to Cleveland early in life. His first position was with the National Screw & Tack Company, which he held until the organization of the National-Acme Manufacturing Company. He succumbed to an illness of about one month's duration. His wife, his mother, and a young son survive him.

Peter Steele, the general chairman of the Brotherhood of Railroad Trainmen, died at Ottawa, Canada, as a result of an accident at Carlton Place, Ont. He was endeavoring to get on board of the "Soo" train on the Canadian Pacific and fell between the cars. Mr. Steele was about forty-five years old and leaves a wife and two children. His loss will be deeply deplored by a wide circle of friends as well as by the order he officially represented.

Enos H. Tucker, of Needham, Mass., recently died at the advanced age of 93. In 1849 he entered the employ of the Norfolk County and the Boston & Providence Railroad, first as station agent, later on as conductor, and finally as superintendent. In 1857 he returned to Needham as superintendent of the Woonsocket Divsion, Boston, Hartford & Erie Railroad, afterward changed to the New York & New England Railroad, and now a part of the Central Division of the New York, New Haven & Hartford Railroad. He held this position until his retirement from railroad life, about 10 years ago. Mr. Tucker turned his energies toward political life, and after securing a seat in the Legislature was elected a Senator from the Second Norfolk District. He was a member of the committee on steam railroads while in the Senate.

Hollow Wedge Bolt.

On the Birmingham & Southern Railroad they use a hollow wedge bolt on their engines which Mr. J. A. Monfee,



HOLLOW WEDGE-BOLT ARRANGEMENT.

the master mechanic at Pratt City, Ala., tells us has given every satisfaction. The hollow bolt, he says, is a good one under the firebox where a leak may wash off the oil between the frame jaws and the wedges. Our illustration, made from Mr. Monfee's sketch, will show what the bolt is like.

A wedge bolt 1¼ ins. diameter is used, and this has a hole right up through the center of it, 11/16 in. diameter. A ⅝-in. bolt with a square head in the wedge is passed down through the hole in the large hollow wedge bolt. Where the large wedge bolt bears against the bottom of the wedge, a piece of steel ¼ in. thick by 1½ ins. long and 2 ins. wide, is placed so as to prevent the point of the hollow bolt cutting up into the cast iron of the wedge.

After setting up the wedge in its proper place, and tightening the lock nut on the large hollow wedge bolt, a couple of ⅝-in. nuts are tightened up on the bottom of the projecting end of the ⅝-in. bolt, which comes down through the hollow wedge bolt. By this arrangement the wedge is held up by the large wedge bolt and so cannot work down, and it is held down by the ⅝-in. bolt and cannot work up. The wedge therefore stays where it is set and there is no slack, and no chance to move either way. The wedge so held cannot work up and down with the axle box, and there are consequently no cut jaws and no wedge bolt heads jerked off.

The bolt can be applied without taking down the bottom brace, and the whole thing has given perfect satisfaction on the B. & S. big 21x26 in. engines. By this arrangement a wedge once put in place will stay put, and that saves time, trouble and money.

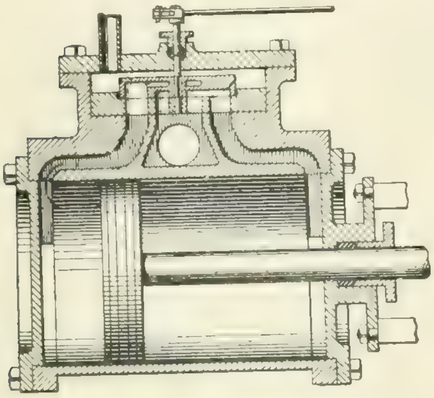
The Standard Steel Works Company of Philadelphia have reprinted in standard size the paper on "Steel Tires—Causes of Defects and Failures," read by Mr. G. L. Norris before the Western Railroad Club on Oct. 18, 1907. This is one of the most interesting of the many interesting club papers. Editorial mention was made of it in our January issue, page 16. The form in which the Standard Steel Company have reproduced the article leaves nothing to be desired. The half-tone illustrations are beautifully executed, and the reproductions of defective wheel treads are simply perfect. The micro-photographs of the steel at and about the defective spots in the tire are clear and distinct and show the structure at a glance. The presentation of the subject is complete and the reproduction of which we write is such that it becomes a pleasure to look over and study Mr. Norris's facts and figures. It is a handy, useful and interesting reference pamphlet and can be had from the Standard Company by simply asking for it.

The machine knives of Loring, Coes and Company, Worcester, Mass., are fast approaching the popularity already attained by Coes' wrenches. Not only are the fine products of this company the very best, but their methods of advertising are masterly. We have just received a blotter that rubs out the remembrance of anything of the kind we have seen before. A layer of red, white and blue pads are overlaid with a celluloid sheathing whereon are clustered a segregation of youth and beauty bright as butterflies and lovely to look at. Ask the company to send you a blotter and they will be pleased to do so, and you will be also pleased.

Patent Office Department

ENGINE VALVE.

Mr. B. Hanson, Schroyer, Kan., has patented an engine valve, No. 854.036. It operates on an engine cylinder having a steam chest with special parts communicating with the interior of the steam chest and an intermediate exhaust port. There

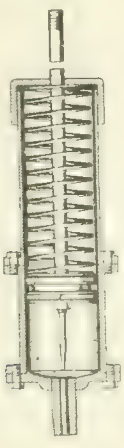


LOCOMOTIVE DISC VALVE.

is a block removably disposed within the steam chest having ports registering with the steam ports of the cylinder and also with the exhaust port on which a passaged valve is mounted to oscillate on the block, the oscillating valve being furnished with recesses adapted to register alternately with the ports in the block, and regulating the admission of steam into the cylinder.

AUTOMATIC BRAKE.

Mr. James Lynch, Van Buren, Ark., has patented an automatic brake, No 875,-

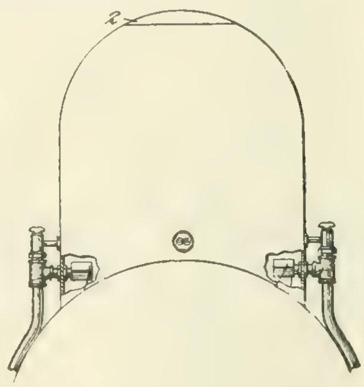


AUTOMATIC BRAKE VALVE.

543. The device embraces in combination an air cylinder, a piston working therein, a spring tending to move the piston within the cylinder to apply the brakes and means for cushioning the piston when the brakes are suddenly applied. A stem attached to the air cylinders affords means for choking the flow of air as the piston advances. The action of the spring has the effect of applying the brakes in case from any accident a car should become detached from the train, and also in the case of a failure of the air service in applying the brakes.

TRACK-SANDING DEVICE.

Mr. J. W. Brady, Neodesha, Kan., has patented a sanding device, No. 877,-828. The device comprises a casing or

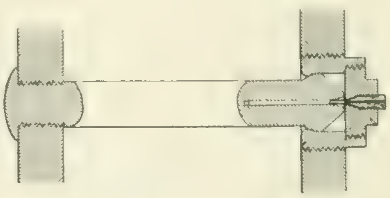


DEVICE FOR TRACK SANDING.

dome, air pipes leading into the casing or dome and cut through the sides thereof. There are nozzles fitted to the air pipes, the nozzles being fitted in couplings connected to the sand pipes and hoods connected to the sand pipes inside the casing or dome. The fittings and couplings are readily detachable.

FLEXIBLE STAY BOLT.

A flexible stay-bolt has been patented by Mr. H. A. Pike, New York,

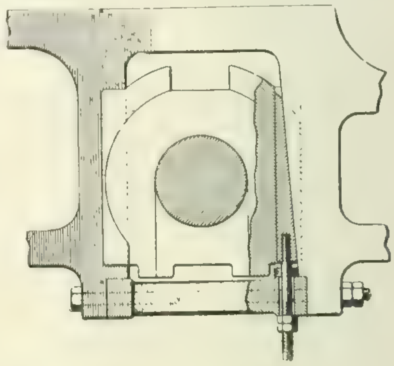


FLEXIBLE STAY-BOLT.

N. Y., No. 876,912. The structure comprises the usual bolt, a sleeve-plug fitting the plate of a boiler-shell and having a seat for the bolt-head. The bolt has a central bore, and there are means carried by the sleeve-plug for retaining the bolt in place and a flexible connecting member between the retaining means and the bolt. A marked feature is means having an aperture communicating with the bore of the bolt.

DRIVING BOX WEDGE.

A wedge for locomotive driving boxes has been patented by Mr. W. J. Barrett, Chicago, Ill., No. 873,148. The device embraces a wedge and pedestal brace of the usual form, with an adjusting bolt pass-

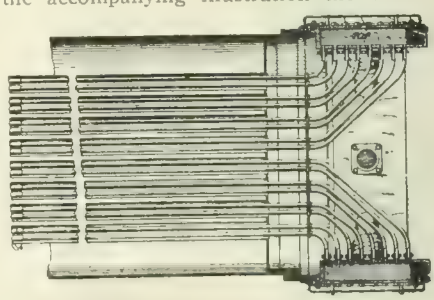


ADJUSTABLE DRIVING BOX WEDGE.

ing loosely through the brace. The lower end portion of the wedge has a threaded socket which receives the upper end portion of the adjusting bolt. There is an adjusting nut on the lower end of the bolt, the nut bearing upon the under side of the pedestal brace. There is also a second adjusting bolt passing loosely through the pedestal brace, and bearing at its upper end upon the lower end of the wedge, a dead nut arranged upon the bolt, the dead nut having a collar which rests in a socket on the pedestal brace, the lower end of the bolt having an adjustable nut.

SUPERHEATER.

An improved steam boiler superheater has been patented by Mr. F. J. Cole, New York, N. Y., No. 875,895. As shown in the accompanying illustration the device



LOCOMOTIVE SUPERHEATER.

embraces the combination of a steam header supported to the shell of an ordinary boiler smoke box and divided into receiving and delivery compartments. There is a plurality of pairs of superheater pipes extending in U form in tubes of the boiler and having the forward portions bent laterally to communicate with the steam receiving and delivery compartments.

Snow Fighting in Scotland.

By Angus Sinclair

The snow blockade scenes shown in the annexed engravings, were pictures taken on the Caledonian Railway in Scotland near Laurencekirk, a village in the northern part of the great Valley of Strathmore, twenty-six miles south of Aberdeen. The scenes give a true representation of snow fighting as it is practised to-day on one of the most important trunk railways in the British Isles. The scene is peculiarly interesting to the writer for he had undergone some personal experiences connected with the buried cutting in the picture where three heavy locomotives have vainly tried to force an opening through the drifted snow.

When I was a boy five or six years old my father was a gateman at a level crossing at the entrance to the cutting shown. The cutting is about one and one-qaurter mile long and varies in depths from zero to twenty-five feet. There is a public highway on the west side of the railway from whence come most of the snow drifts, precluding the use of trees to act as a snow protection. To the west is a long stretch of fields over which the snow drifts with ceaseless force when a snow storm is raging. Very bad snow storms happen only at intervals of four or five years, which is the reason why heroic measures are not taken to protect this cutting.

One of my most vivid recollections of boyhood days, was sitting in my father's cabin one forenoon watching the snow drifting into the cutting. The storm was something like a western blizzard for it filled the air and a white river kept flowing out of the fields into the cutting which soon was filled level on the shallow part.

I clearly remember the trepidation of my father about the fate of a train that was due. He was facing a new condition for which experience or rules gave no guide. Would he flag the train or let it dash into the snow barrier with perhaps disaster to the train? Experience is needed to teach people that running into a deep snow drift is not dangerous. Like a wise man, as he was, he compromised and signaled caution. On the train came, however, without abated speed, plunged into the deep drift and stopped.

SNOW BUCKING ON THE CALEDONIAN RAILWAY.

Getting stalled in the snow was a new experience to railway passengers in those days, and the people in this train were seized with blind panic and proceeded to tumble out of the carriages as if a contagion raged within. Where doors could not be opened the windows were used and a tumultuous mass of men and women was soon struggling in the snow shouting for mercy and help. In vain the guard assured the people there was no danger. By degrees the panic exhausted itself and the passengers climbed back into the cold cars.

SUMMER VIEW OF LAURENCEKIRK STATION ON THE CALEDONIAN RAILWAY.

It happened to be a heavily loaded excursion train bound to some high event in Aberdeen, and the people were sufficiently numerous to swamp the sleeping and eating accommodations for strangers provided by the village. They were with us three days before the line was cleared, and oatmeal and porridge was a luxury before the last of the excursionists departed.

Ten years later I was telegraph clerk at the station when another snow blockade happened by the drifting up of the same cutting. That involved glorious excitement to me, for I was kept in the office three days and three nights, eating and sleeping there. The office was the resort of many of the delayed trainmen, and there I received the first taste of the stories that train people all the world over are famous for telling, about their adventures and awful experiences.

CLEARING THE LINE. WINTER ON THE CALEDONIAN.

When I ventured to repeat some of the stories to my mother, no mean story teller herself, she declared them a pack of lies, and assured me she could tell better stories herself!

Five or six years more years passed away. I was working in the railway repair shop at Arbroath, where I had previously been telegraph clerk to the Locomotive Superintendent, Mr. Yarrow. A messenger brought the important news one day that Yarrow wanted to see me. Later I learned that the line was snow blocked at Laurencekirk and that I was going with the relief party, so that I could do any telegraphing needed. The superintendent gladdened my heart by saying that I would be permitted to fire one of the engines.

We started, one of the party full of glee and anticipations of a delightful time. There were two engines and a heavy push plow. For some idiotic reason, the engines were placed tender to tender, that on which I operated backing up. There was no shelter, and when a snow drift was struck the snow plow shovelled it over upon our footplate, making it very uncomfortable to the enginemen. A stop was made before we reached the deep cutting. I filled up the firebox to make sure of steam, and we were told to work for all the engine was worth. By the time we reached the spot, where I had first seen a train snowed under, no part of our engine was visible.

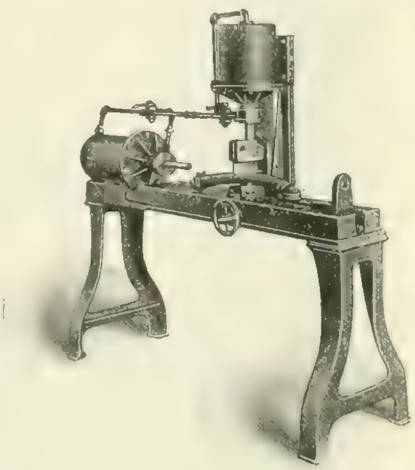
I have bucked snow many a day since that time, but I never was so nearly getting smothered as I was on my last dash into the Laurencekirk cutting.

Up-to-Date.

There is a very handy shop tool on the market or rather, we should say, tools, because several are combined in one machine. Probably on account of the fact that such a combination has been effected the makers use an up-to-date name to indicate its various uses. They call the machine the Twentieth Century Outfit. This machine does business with hose, air brake and steam or hose used in the shop for that matter, and it can be put to four distinct uses. It is a hose bolt cutter, also a hose stripper, a hose fitter and a hose cutter.

The machine only weighs 1,000 lbs. and stands 5 ft. 6 in. high and takes up just 2 x 6 ft. floor space. It has two air operated cylinders, one being placed vertically and the other horizontally. It can therefore hold and push or hold and cut vertically and horizontally according to which cylinder does the holding and which does the work. When you want it to work in any one of its four ways you arm the piston rod ends with appropriate tools, which are supplied with the machine, and the machine does the rest. The makers say of this Twentieth Century Outfit that as a hose fitter it will mount more hose and apply more clamps with one man to operate it than a half dozen men could mount in the old way, and as a bolt cutter it will cut more bolts than a dozen men could cut with chisel and hammer. As a hose stripper it will do its work with about the same margin in its favor, but when it comes to cutting hose for splicing its capacity is limited only by the ability of the operator to give it hose to cut.

In the opera called "The Mikado" you will remember that *Poo Ba* did the work of quite a number of men in his several "capacities." Well, here is a machine which has also a number of capacities, but there is nothing comic about the machine. It is just business. You may say that it has more than a mere majority, if you prefer political language, for it has really a plurality of functions and when "elected" it serves its constituents with faithfulness and with credit to itself. At a recent trial in the Pullman Company's repair shop at Chicago we are informed that the Outfit mounted new steam hose of the largest size at the rate of three every sixty-five seconds. If you want to know more about this machine drop a line to Buker & Carr Manufacturing Company, 19 Fairview Heights, Rochester, N. Y., and they will tell you all about it.



ONE OF ITS USES—A HOSE CUTTER.

Vapor Lighting System.

For the lighting of branch line cars which cannot obtain a supply of Pintsch gas, the Safety Car Heating and Lighting Company have developed a system by which the use of carburetted air is employed in connection with incandescent mantle lamps. This system was made possible by the previous development of mantle lamps for railroad service. One disadvantage of the earlier

system was the low luminosity of the gas in cold weather. With incandescent mantles it is possible to obtain good results with gas that is non luminous. Another disadvantage of the old system came from the fact that a carburetor had to be placed directly over each lamp, as it was impossible to have a large carburetor to supply all the lamps, owing to the condensation of some of the gas which formed a liquid that collected in the piping at any fall of temperature. These carburetors had to be placed on the car roofs, over the lamps, as it was necessary that each carburetor should be warmed in cold weather.

Using incandescent mantles it is possible to get excellent results with non-luminous gas. If the gas formerly used had always been of this kind no condensation in the piping would have taken place, even at low temperatures. In this new system, the gas is always non-luminous. The required uniformity of quality is obtained by varying the pressure under which the gas is generated in the carburetor, in accordance with the temperature, thus making it possible to use a carburetor of substantial construction under the car, and distributing the gas to the lamps by a piping system similar to that for a car lighted by Pintsch gas.

The operation of the vapor system is as follows: Air is taken from the auxiliary air reservoir of the brake system, and brought through a check valve to the air storage tank of the lighting system, and from this tank it passes up to the saloon of the car where a pressure gauge and shut-off valve are placed. This gauge shows the pressure of air in the air storage tank. From the saloon the air passes to the high pressure regulator which automatically puts a pressure on the carburetor in accordance with the temperature. In passing through the carburetor the air takes up sufficient gasolene vapor to make the proper kind of gas. From the carburetor the gas passes through a low pressure regulator which reduces the pressure to that suitable for burning in the lamps. The lamps are similar in design to those used for Pintsch gas and have the same mantle. The carburetor is contained within the air storage tank and is formed by running a 12-in. pipe through the center of a steel holder 20 ins. in diameter. The ends of the pipe are brazed to the heads of the holder and closed by iron plates securely bolted on. The pipe is packed full of wicking which absorbs the gasolene. The air passing through this wicking takes up the requisite amount of vapor to form the gas. By this means the carburetor is well protected, as it is wholly within the walls of the air tank. A combined air tank and carburetor, 20 ins. in diameter by 8 ft. 6 ins. long, has, when charged, 20 gallons of gasolene, and will supply five 100-candle power lamps for at least 200 hours. The Intercolonial Railway of Canada recently built three gasolene motor cars for suburban and branch line service and these car's are lighted by the Vapor lighting system here described. The Safety Car Heating and Lighting Company of New York will be happy to answer all inquiries on this subject which may be addressed to them.

INTERCOLONIAL MOTOR CAR EQUIPPED WITH THE VAPOR LIGHTING SYSTEM.

The Holmes metallic packing which has been subjected to a very exacting and at the same time very satisfactory test on the Philadelphia & Reading last year, is made by the Holmes Metallic Packing Company, of Wilkes-Barre, Pa. This packing we are informed by the makers is furnished subject to thirty days' trial and is guaranteed for one year. The parts liable to wear are the rings which can be renewed at small expense. The packing is guaranteed to be steam tight, and not to score, scratch or blister the rod, and references on this point will be given by the company upon application. The packing is fitted with a patent swab pocket which is intended to catch any foreign substance which may get on

the rod, and if allowed to find lodgment in the packing tend to score the rod and wear it unevenly. The packing is made of a special frictionless metal, thereby requiring less oil and saving fuel. The Holmes packing on P. & R. Engine 1356 is still in service and on Feb. 11 last had been two years in continuous service. Write to the company for further information if you are interested.

The Lima Locomotive & Machine Company of Lima, Ohio, are the makers of Shay patent and direct locomotives. They have just issued a very comprehensive, illustrated catalogue, in which they give a specification of the Shay geared engine and indeed of all the engines they turn out. They also give the physical tests of materials used. There are a few words on the service for which the Shay locomotive is adapted and some facts which the makers require to know, so that the best results may be secured. The catalogue is 6 x 9 ins., and is suitable for filing in the M. C. B. cabinet. It is excellently illustrated with a large number of Shay engines of various sizes and styles. Under the head of Rod Locomotives may be found an assortment of Forney engines, light saddle tank engines, 2-4-2 type, 4-4-0 engines, moguls, prairies, switchers, and in fact all ordinary types. In the last few pages there is a lot of useful information showing how to calculate the tractive power of a locomotive, the resistance of trains, a table of the number of revolutions per mile of various sized driving wheels, the estimated amount of material for one mile of track of different weights of rails, limit of weight of rod locomotives on various weights of rail. Altogether the catalogue is a very handy thing to have beside you, and the Lima Locomotive & Machine Company will send you a copy for the asking.

Fire Brick and Other Matters.

In our questions answered column this month we gave on the request of a correspondent a brief bit of brick arch history. Almost as a sequel to this we have just received an exceedingly valuable catalogue, or rather we should say, pocket book, from the Harbison-Walker Refractories Company, of Pittsburgh, Pa. The book is of convenient pocket size and is handsomely bound in dark leather, and has gilt-edged pages. There are some remarks in the first few pages on what various kinds of fire brick and other refractory substances are and what they are most suitable for.

The catalogue is illustrated with appropriately colored cuts of the many sizes and styles of the bricks made, and any one not familiar with the subject would be astonished by the variety. The line cuts which follow, showing the furnaces, cupola converters, etc., etc., are beautifully executed and stand out well on the heavy glazed paper used in the catalogue. On page 70 there is some general information about fire brick and this is followed by a table of wedge brick showing how a circle or arch of any diameter may be laid up with a combination of the standard size fire brick made by this company. The book also contains a lot of useful information, such as the melting temperatures of various substances, both in degrees Centigrade and Fahrenheit, also the temperatures produced in the various process in steel making.

Then follows a table of the areas and circumference of circles and the decimal equivalent of an inch, the weights of all sorts of materials in pounds per cubic foot. The equivalent figure for the temperature of each thermometer, so that if you want to know what, say 68 degs. F. would equal in degs. C., you don't have to work it out, you look it up, that is all. In fact this pocket book which contains general information in connection with the use of silica, magnesia, chrome and fire clay brick and various other refractories is got up on the "look it up" principle and not the "work it out" idea, so it saves time and trouble, and the information is there. The book is worth having, but it is not given away to everybody. There is one requisite, however, and that is that you shall possess the desire to obtain a copy, and if you express that desire by letter or post card, addressed to the company, and say we told you to do so, the book is yours. When you get it you will find some blank pages for your own notes and memoranda, at the back.

The Smooth-On Manufacturing Company have recently opened an office at 61-69 North Jefferson street, Chicago, also another office at 20 Sacramento street, San Francisco, Cal., and an office in the British Isles. The latter is at 8 White street, Moorfields, London, E. C. This company are sending to their friends a little folder which they call "History." It is a history and a brief description of the various Smooth-On cements. If you have not yet obtained a copy, drop the company a post card and they will very willingly send you one. Address Jersey City, N. J.

On February 5, 1908, the Secretary of State of Canada issued supplementary letters patent changing the corporate name of "The Locomotive & Machine Company of Montreal, Limited," to that of "Montreal Locomotive Works, Limited."

Jenkins Brothers of New York, the well-known makers of Jenkins' standard '96 packing and Jenkins Bros.' valves, have just issued a supplement to their regular catalogue. The supplement supersedes pages 70 and 71 of their 1907 catalogue and deals with extra heavy gate valves for 250 lbs. working pressure. The supplement contains twelve pages and is illustrated throughout in conformity with the catalogue of which it forms a part. Those who wish to have a copy should write Jenkins Brothers at 71 John street, New York.

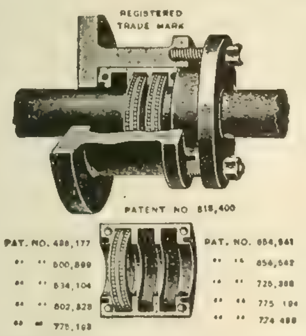
"Air Brake Lubrication" is the title of an attractive booklet of sixteen pages and cover recently got out by the Joseph Dixon Crucible Company, of Jersey City, N. J. The booklet is typographically attractive, being printed in two colors, illustrated and having a striking cover. The little book begins with a description of the air brake testing rack installed at Purdue University by the American Master Builders' Association. This rack embraces a full air brake equipment for two trains of fifty cars each, upon which Prof. Goss made his first tests with Dixon's flake graphite. The data secured from these tests are reported in Prof. Goss' own words. The booklet goes on to explain the preparation and introduction of Dixon's air brake and triple valve grease and names the parts of the air brake system on which this lubricant can be used to advantage. The lubricating troubles usually experienced with the air brake system are pointed out and the remedies are given. The pamphlet closes with a few pages on the lubrication of air pumps. All those interested in the train service, should have a copy of this new edition, which may be obtained free by writing direct to the Joseph Dixon Crucible Company, Jersey City, N. J.

The Arlington Manufacturing Company, of Canton, Ohio, have just issued a handsome catalogue descriptive of their standard paints. Their list includes all the colors and kinds of paints used by railroad companies, structural steel builders, contractors, manufacturers and industrial plants. The company's products have grown in popular favor for many years, and their iron fillers and machinery paints are much used in railroad work. One of their recent innovations is the introduction of a new combination paint known as "Quikdry," by the use of which a freight car may be painted two coats, stenciled and put in service in one day. In repair work, the use of this paint is of much value, saving time and adding to the earning capacity of the equipment.

There is an excellent car replacer made of steel shown on pages 77 and following, of the new catalogue got out by the Washburn Steel Castings and Coupler Company of Minneapolis, Minn. The replacers are shown in a side view, also how they look on the track and how they do their work. In any dispute between a derailed truck and a pair of these replacers, the replacers come out ahead. The catalogue is a well and clearly illustrated publication of 93 pages, and gives views, descriptions and figured drawings of couplers, draft riggings, bolsters and trucks as made by this company. There are passenger couplers and freight couplers, bolsters, switch engine couplers, pilot couplers. The narrow and broad gauge combination coupler is a cleverly designed thing and the pivoted spring buffer for passenger cars is shown in detail. One of the illustrations is of Sir Thomas Shaughnessy's private car, the "Killarney," on the Canadian Pacific, which is equipped with Washburn couplers and draft rigging. The catalogue will be sent to any address upon application being made to the company.

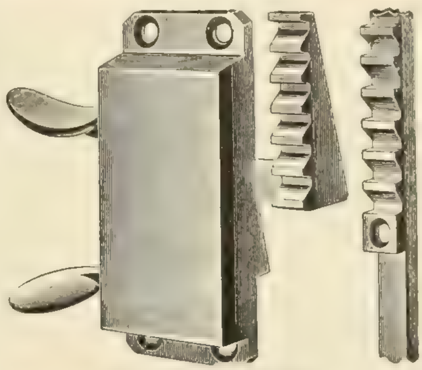
The Record of Recent Construction, No. 64, got out by the Baldwin Locomotive Works of Philadelphia, is devoted to the description of locomotives which this firm has built for the Central Railroad of Brazil. There is an interesting description of the road in the opening pages of this "Record." The first locomotives shipped to Brazil from the Baldwin Locomotive Works were built in 1862 and were for the Dom Pedro Segundo Railway. Two were 4-4-0 and one was a mogul. It is an interesting record and the half tones show the changes and the growth of the locomotives as time went on and as order succeeded order. The Brazilian locomotives necessarily have a somewhat foreign look to our eyes, but there is always something about them distinctively Baldwin. This record No. 64 is a most interesting one, and the well known locomotive builders will be happy to send a copy to anyone who writes to them for one.

The Niles-Bement-Pond Company, of 111 Broadway, New York, have just issued their list No. 15 which is a tabulated description of the stock of second-hand metal working machinery which they have on hand. There are among this assortment ten axle lathes and wheel borers; forty screw cutting lathes; nine speed lathes, nine lathes not screw cutting; eighty turret head plain and wire feed hand and automatic screw machines; eighteen planers; eight shapers; nineteen drills;



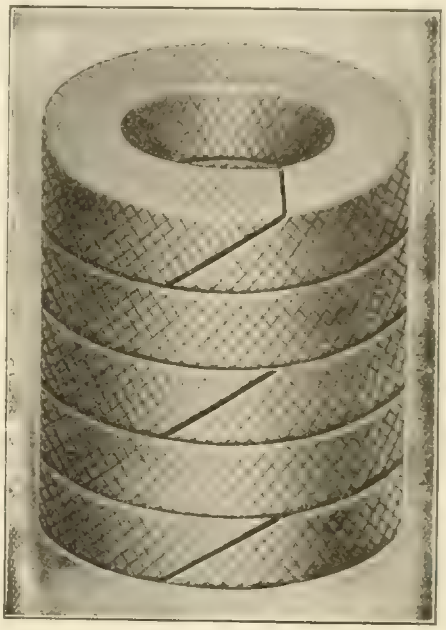
thirty-three multiple spindle drills; thirty four milling machines and profilers; eight boring machines; twelve punch presses, shears, etc.; thirty two grinding and polishing machines; and twenty-eight miscellaneous machines. This makes 340 machines in all, each numbered and described. With this list in one's hand it is only necessary tc quote the catalogue number to ascertain price or other particulars. List No. 15 will be sent to those who write for a copy. This catalogue gives the condition each machine is in, and is a good list to look over in these strenuous times if a few serviceable machines are required to complete a shop outfit.

You know what a disagreeable thing a loose rattling window sash is. It is in fact a comfort destroyer, and if you want to take a nap it won't let you. The Patterson Tool and Supply Company, of Dayton, Ohio, have been camping on the trail of the loose sash and they have bagged the game. They call the device a sash retainer and anti-rattler. A neat



CAR SASH RETAINER.

little toothed strip of brass is secured to each of the inner strips of the window frame. On the sash at each side is their lock which somewhat resembles the ordinary sash lock in appearance. That is, it is neat and compact, but it is far ahead of the old fashioned bolt and socket idea. The anti-rattler has a wedge shaped piece fitted with teeth which engages one on each side with the toothed strips on the window frame. The teeth make it possible to secure the sash at any desired height while its wedge shape causes it to take up the play between sash and frame. The sash therefore stays up and does not rattle and there are no ratchets exposed, to mar the beauty of the car. The bolt and socket plan only gave you the choice of two positions, a six-inch opening or perhaps a ten-inch, while the anti-rattler allows you to adjust the opening to quarter inches. You can notch up the sash as a locomotive engineer does the reverse lever of an engine, and with much less exertion. If you are interested, drop a post card to the company and ask them for their folder.



INDEX TO ADVERTISEMENTS.

Railway and Locomotive Engineering

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A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXI. 136 Liberty Street, New York, April, 1908 No. 4

New York and New Orleans, Limited.

The principal train on the Southern Railway bears the name of the New York and New Orleans Limited. The southbound train is No. 37 and the northbound is No. 36. The two cities, which with the prefix "New" in their names were called after two important centres of population in the old world, are neither of them on the Southern Railway. That road, however, is the principal link in the five railways over whose lines the traveler would pass in going from New York down to the city of New Orleans.

NEW YORK AND NEW ORLEANS LIMITED ON THE SOUTHERN RAILWAY.

The section of country over which the

train runs when on the rails of the Southern, lies between Washington, D. C., and Atlanta, Ga., a distance of 648 miles. The run takes 19¼ hours, and is at the average rate of a little over 33½ miles an hour, though the speed is of course greater, as brief stops are made at important points such as Lynchburg, Danville, Greensboro, Salisbury, Charlotte, Spartanburg and Greenville. The train's speed may be quite up to that of the "White Moth," if you take the trouble to work it out.

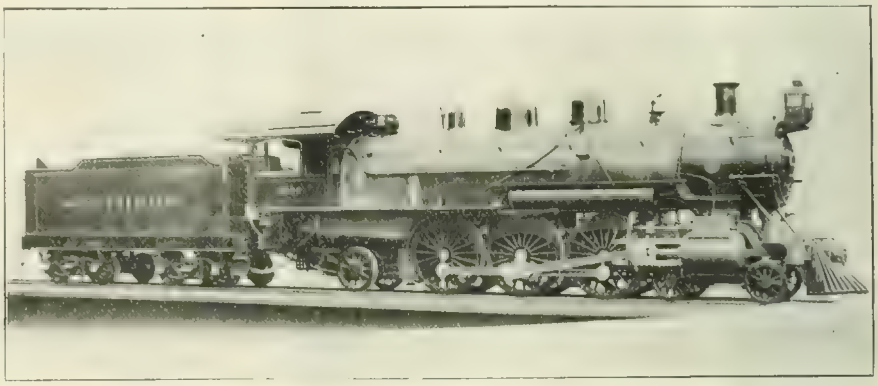
The Southern Railway between Washington and Atlanta makes a comparatively straight line on the map, and as Atlanta is about 400 miles south of the national capital and about the same distance to the west of it, the railway forms the long side, or hypotenuse, of a triangle whose right angle would be out in the Atlantic Ocean, probably beyond Cape Fear. Washington lies in about the same latitude as the city of Lisbon in Portugal. That portion of the Southern Railway over which the New York and New Orleans Limited runs may be said to be along the range of mountains known as the Blue Ridge. This is one of the several parallel ranges which are spoken of in a general way as the Alleghenies.

The train itself is a solid, electrically lighted Pullman train with drawing-room, sleeping and observation cars from New York to New Orleans, a club car from Washington to New Orleans, and sleeping cars from Norfolk, Va., which are added to the Limited at Danville. A dining car service is of course part of the equipment. A traveler can leave New York at half past four in the afternoon and arrive at New Orleans at 9:40 on the second morning thereafter.

The engines which are used to haul this magnificent train are of the Pacific or 4-6-2 type, built at the Baldwin Locomotive Works. The engines have cylinders 22 x 28 ins. and the driving wheels are 72½ ins. in diameter. For the sake of grasping the idea of what these long train runs mean we may say that the distance between Washington and Atlanta is almost 3½ million lineal feet, and the driving wheels of the engines hauling them would in all make more than 180,000 revolutions in traveling the distance.

The tractive effort of these engines is about 34,900 lbs., and with a weight of 143,690 lbs. resting on the drivers, the factor of adhesion becomes 4.11. The heating surface is in all 3,878½ sq. ft., and the fuel capacity of the tender is about 12 tons, and the tank carries 7,500 gallons of water. One of our smaller half-tones shows the machine of steel and steam which one of our correspondents has poetically called the "King of the Continent."

Our frontispiece this month shows the New York and New Orleans Limited in an almost straight front view, bowling along southward with a train, perhaps the very counterpart, except in color, of the millionaires' southbound express of which Rudyard Kipling tells us when he speaks of "the White Moth that takes the overflow from the Purple Emperor, tears south with her seven vestibuled cream-white cars," and like the Emperor, just showing "a bar of white light from the electrics in the cars and a flicker from the nickel-plated hand rail on the rear platform."



MODERN EXPRESS PASSENGER POWER ON THE SOUTHERN.

A GLIMPSE OF THE ROAD TO THE SUNNY SOUTH.

John Edgar Thomson,

ENGINEER AND RAILROAD MANAGER.

The modern system of railroad management and operating was inaugurated in the United States by the Pennsylvania Railroad Company, which constituted a model for the organization of nearly all other railroad lines on the American Continent. During the first thirty years of railroad operating in this country practically all the railroads were short sections that could be traversed in a few hours; and the various state legislatures displayed a strong tendency to keep the railroads short and to throw obstacles in the way of amalgamation that would promote through lines of travel.

Under this policy the expenses of operating railroads were so high that charges for transportation were necessarily what would now be considered exorbitant. The movements of travelers were also painfully tedious and subject to harassing delays at terminal points short distances apart where change of cars had to be made, and it was frequently necessary to move considerable distances over execrable roads to other terminals.

ORIGIN OF PENNSYLVANIA RAILROAD.

The Pennsylvania Railroad was originally a Philadelphia enterprise, promoted by the people of that city to retain to themselves a share of the com-

merce for the rapidly growing western population. The Erie Canal and the Erie Railroad, well under construction, threatened to monopolize the carrying trade for the whole territory north of the Delaware River, while the Baltimore & Ohio Railroad Company were

RIVER BESIDE THE SOUTHERN.

preparing to become the Westward carriers for all the remainder of the Atlantic seaboard marts of business. The danger of innovation upon Philadelphia commerce became more and more apparent as the '40's advanced. Defensive measures culminated in 1846, when a group of the most substantial citizens of Philadelphia organized the Pennsylvania Railroad Company and obtained a provisional charter to construct a railroad from Harrisburg to Pittsburgh. Several short railroads already connected Harrisburg with Philadelphia.

PHILADELPHIA FELL FROM GREATNESS.

Philadelphia had fallen from greatness. Until the completion of the Erie Canal in 1825 Philadelphia had been the largest city in the Union, also the commercial and financial capital of the United States, while it held the largest share of Western business. Disaster after disaster followed the misfortune of the Erie Canal. The financial crisis of 1839 with the failure of the United States Bank and consequent failures in commercial circles prostrated Philadelphia, and for a time disheartened the public men who had formerly been noted for their courage, enterprise and integrity.

The movement of 1846 towards building an all rail line to Pittsburgh represented a revival of the old spirit that had made the great city on the Delaware the largest and richest in the country. Prior to the organizing of the Pennsylvania Railroad Company the people of Philadelphia had made an effort to retain part of the Western carrying trade, but their enterprise produced very meagre results.

A NATURAL TRADE CENTER.

The confluence of the Allegheny and Monongahela Rivers forming the Ohio River constituted a trading post that had no equal when the United States was "winning the West." In the days when the trade products west of the Appalachian range of mountains consisted principally of pelts and other products of the hunter's skill, the commercial interests of the Seaboard States did their best to secure the business. It was trading instincts rather than patriotism that sent Braddock to disaster in his expedition against Fort Duquesne, which then represented the Western entrepôt of trade.

The promoters of the Baltimore & Ohio Railroad understood the importance of reaching Pittsburgh, and that was the real point sought when they planned to arrive at the Ohio River.

THE PENNSYLVANIA STATE ROAD.

As early as 1828, the year after the Baltimore & Ohio Railroad was chartered, inspired by leading citizens of Philadelphia, the Legislature of Pennsylvania ordered the Canal Commissioners of the State to put under contract the construction of a railroad from Columbia to Philadelphia via Lancas-

JOHN EDGAR THOMSON.

ter. The promoters of this enterprise threw *poudre aux yeux* of the hayseeds by giving the rural town the greatest prominence in the name of the railroad.

The railroad was duly built and operated by the State of Pennsylvania, its principal purpose being to establish a through route to Pittsburgh. The route was established sure enough, but it was too circuitous to prove popular or to compete fairly with more direct lines of travel. It was a mixed rail and water route which entailed several transfers of freight and took about five days to make the journey between Philadelphia and Pittsburgh.

The movement to make an all rail route route between Philadelphia and Pittsburgh was very vigorously pushed after the charter was secured. An unusually intelligent board of directors was elected, and they displayed uncommonly good sense in appointing John Edgar Thomson chief engineer, which was one of the most important events in the history of the Pennsylvania Railroad Company.

JOHN EDGAR THOMSON.

John Edgar Thomson was born in Delaware County, Pennsylvania, February 18, 1808. His father, John Thomson, who belonged to a race of Scottish engineers, had been engaged on important public works of various kinds, among them the construction of what was one of the first railways or tramways on the American continent, which was made to connect stone quarries at Crum Creek and Ridley Creek, belonging to Thomas Leifer. Mr. Thomson took charge of the education and professional training of his son. When 19 years of age young John began work on the survey of the Columbia & Philadelphia Railroad, and remained so engaged until a delay on the survey happened, through want of an appropriation of money by the Legislature, when he was appointed principal assistant engineer of the Camden & Amboy Railroad. In 1832 he went to Europe for the purpose of studying details of railway construction abroad. On his return to the United States Mr. Thomson was appointed chief engineer of the Georgia Railroad, at that time the longest line in the world under the control of one company. He continued in that position for fifteen years, when in 1847 he was elected chief engineer of the Pennsylvania Railroad.

Mr. Thomson held various titles before he became president of the company, but from the beginning of his connection with the road he was really general manager. To his supreme engineering ability and to his extraordinary business capacity the Pennsylvania Railroad Company was indebted for its rapid rise to the foremost place among the railroad corporations of this continent.

ALONG THE SOUTHERN ROAD.

Extraordinary difficulties had to be overcome from the initiation of the Pennsylvania Railroad in order to keep pace with the demands of those who were promoting this new route to the growing West. Many people looked

upon it as the railroad that was going to drag the trade of Philadelphia out of the slough of despond and their eagerness to see the work pushed knew no bounds. Contracts had to be let and a department of transportation organized. Surveys of a most difficult character had to be made and made with extraordinary skill and care, for a company constructing a railroad over high mountains could not afford to have mistakes made.

The company had the opportunity of establishing a carrying business between Philadelphia and Pittsburgh by means of the Philadelphia & Columbia Railroad, with its canal and portage connections westward. The necessary organization for managing this line of transportation was organized and put into successful operation, although the politicians who managed the State Road, as it was called, never failed to throw every obstacle they could scheme in the way of the Pennsylvania Railroad people.

RAILROAD AS A PUBLIC HIGHWAY.

The Philadelphia & Columbia Railroad State property was operated as a public highway on which any citizen could run vehicles on payment of legal tolls. Harrisburg was made the first headquarters of the Pennsylvania Railroad and continued so to be until the road reached Altoona. Harrisburg had direct rail communication with Philadelphia by means of the State road and the Harrisburg & Lancaster Railroad.

On July 7, 1847, ground was formally broken at Harrisburg, a contract for fifteen miles of grading having been awarded some weeks previously. The work of construction was pushed with extraordinary vigor and grading was soon progressing at both ends of the line. Mr. Thomson had organized corps of engineers that proved highly efficient in conducting the constructing operations. Every man had his own duty to perform, and if he failed there was no difficulty in locating the defective link in the human chain.

The physical features of the country traversed made railroad construction extremely difficult; and in some portions the obstacles to be overcome were stupendous; yet the forward progress of the work was as steady as fate. About three years after the first sod was cut at Harrisburg, connection was made with the Allegheny Portage Railroad at Hollidaysburg. That was in September, 1850.

ALLEGHENY PORTAGE RAILROAD.

The Allegheny Portage Railroad is now merely a reminiscence, with marks of its footprints to be traced in wild woods and mountain declivities, where it originally defied the Allegheny Mountains to stand as an insuperable barrier to stop the Western current of civilization. The Allegheny Portage Railroad—put into operation in 1834—was the first achievement of carrying a railroad over a chain of mountains, and it was for years regarded as one of the wonders of the world. The railroad with its planes was thirty-six miles long and reached an altitude of 1,339 feet.

RUINS OF THE OLD ALLEGHENY PORTAGE ROADBED.

Mr. Thomson decided that this Portage Railroad should be used as a route over the mountains until the work on a permanent location should be carried out. He accordingly directed that grading from both ends should be worked towards the Portage Railroad. This facilitated the railroad building so much that cars were run from Philadelphia to Pittsburgh in 1852.

During the various surveys made by the engineers of the Pennsylvania Railroad in search of the easiest route over the mountains a belief prevailed that inclined planes would have to be employed on the steepest portion. Moncure Robinson, a celebrated engineer engaged on the work, demonstrated that the railroad could be carried over the mountains by the aid of one inclined plane. Mr. Thomson demonstrated that it could be carried over without any inclined planes and his location was adopted.

When the engineering difficulties surrounding the construction of the railroad were practically overcome in 1852 Mr. Thomson was elected president of the Pennsylvania Railroad Company, and held that important position until he died in 1874.

Mr. Thomson inaugurated the policy of securing control of connecting lines, a policy which eventuated in building up the Pennsylvania Railroad Company to the commanding altitude it holds to-day. As an organizer he was unequalled, and the magnificent organization of the Pennsylvania Railroad, which is to-day the envy of nearly all other railroad companies, was due to his fostering ability.

Mr. Thomson possessed in an eminent degree the faculty of judging men, which enabled him to select assistants who were invariably capable and efficient. The strong *esprit de corps* for which the Pennsylvania Railroad is celebrated and the unmatched discipline among the employees is to a great extent the result of Mr. Thomson's initiation and management.

Automatic CO_2 Recorder.

The Canadian Pacific Railway people are using at their Angus shops in Montreal an automatic recording apparatus which gives a continuous and constantly visible record of the composition of the waste or flue gases from the stationary boilers in the power plant which drives all the machinery and lights the shops, offices and yards.

The apparatus reveals the percentage of carbon dioxide, or CO_2, in the waste furnace gases which are passing out of the power house chimney. Theoretically, 21 per cent. of CO_2 in the flue gases would indicate perfect combustion. The apparatus is graduated from 0 to 20 and the record is within these limits.

It is altogether a cleverly constructed piece of mechanism which is kept in motion by the passage of the hot gas as it goes out to the chimney. The mechanism is not placed in the chimney, but has a convenient position in the engine room

and a pipe connecting with the smoke flue carries a small quantity of the waste gas to a filter and on to the machine. The analysis is automatic and depends upon the absorption of CO_2 by a solution of caustic potash. The record is made by a tracing-pen operated by a lever which is moved by the varying pressure of the gas above the vessel containing the potash solution. A clock-work machine moves a graduated sheet of paper past the tracing pen and this is visible through the glass front of the machine. It is therefore always open to inspection by the firemen as well as by officers of the company and any excess of air or the results of imperfectly burned coal are at once apparent and a remedy can forthwith be applied without waiting for the registering mechanism to be detached or the paper taken out for inspection.

The amount of deviation from the normal in the quality of the firing is thus constantly before the eyes of the performers with the coal scoop and also a useful record of the economy or the reverse in fuel consumption is kept. The machine is an English one and is called the "Sarco" Automatic CO_2 Recorder. We are indebted to Mr. Lacey R. Johnson, assistant superintendent of motive power on the Canadian Pacific Railway of Montreal, for the information concerning this device.

Intends to Know How.

A recent press dispatch from Berlin says: Germany is soon to witness the spectacle of a future ruler in mechanic's overalls, the Crown Prince having matriculated as a student at the Royal Technical High School at Charlottenburg. A few days ago the members of the mechanical engineering class at the school were surprised by the appearance of the prince, who expressed his intention of going through the whole course.

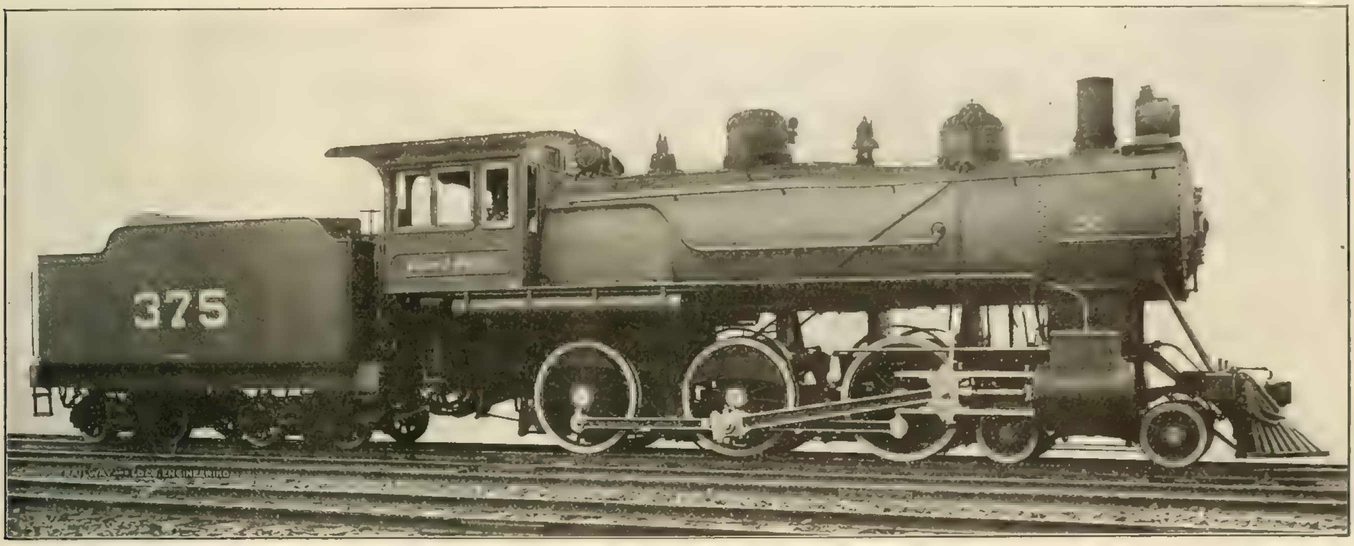
Texas & Pacific Ten-Wheeler.

The Rogers Works of the American Locomotive Company recently completed an order of 20 ten-wheel type locomotives for the Texas & Pacific Railroad, one of which we here illustrate. These engines are intended for freight service, and in respect to weight on driving-wheels and tractive effort they hold, to the best of our knowledge, the record for this type of engine. In working order they have a total weight of 197,000 lbs., of which 165,000 lbs., or 84 per cent., is carried on the driving-wheels. The cylinders are 22 ins. in diameter by 28 ins. stroke, and with a working pressure of 210 lbs. and driving-wheels 63 ins. in diameter they can develop a maximum tractive power of 38,400 lbs. Apart from their tractive power and the large percentage of the total weight carried on the driving-wheels, the design presents no very unusual features, but serves as an excellent example of an engine for all-round service. The factor of adhesion is about 4.3.

The cylinders are equipped with balanced slide valves actuated by the Stephenson type of valve motion. The valves have a maximum travel of 6 ins. The frames are 5 ins. wide and are of cast steel with double front rails keyed and bolted to the main frames. A departure from the usual practice is in the use of under hung springs. The three pair of driving-wheels are equalized together and the weight on each journal is supported by a semi-elliptic spring suspended under the journal box by means of wrought iron spring hangers which hook over the top of the box. The driving wheel base of these machines is 14 ft. 10 ins., the engine itself has a wheel base of 26 ft. 4 ins., while the engine and tender together extend to a wheel base of 55 ft. 9¾ ins. The engine truck carries a weight of 32,000 lbs., and has a fixed centre bearing.

Mr. J. W. Addis, the superintendent of motive power and rolling stock of this road, informs us that these engines are successfully handling 885 tons on maximum grades of 1⅓ per cent.

The boiler is of the wagon top type, with an outside diameter at the front end of 70½ ins. It contains 326 tubes, 2 ins. in diameter and 16 ft. long, and has a total heating surface of 2,931 square feet, of which the tubes contribute 2,731 square feet and the firebox the remainder. The firebox is 99 ins. long and 67¼ ins. wide and has a grate area of 46.3 square feet. This gives about one square foot of grate area for every 63 square feet of heating surface,



SIMPLE TEN-WHEEL ENGINE FOR THE TEXAS & PACIFIC

J. W. Addis, S. M. P. and R. S. American Loco. Co., Builders.

which would indicate that these engines should have good steaming qualities.

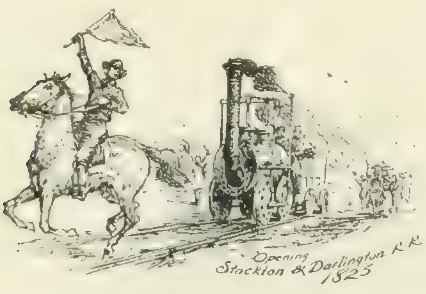
The tender is made with a structural steel frame using 13-in. channels. The tank carries 12 tons of coal and has a water capacity of 6,500 U. S. gallons. The tender weighs about 132,867 lbs. Some of the principal dimensions are here appended for reference:

Driving Journals, 10 x 13 ins.
Engine Truck Journals, 6 x 10 ins.
Tender Journals, 5½ x 10 ins.
Boiler—Material, basic O. H. steel; thickness ring, 1st, ¾ in.; 2d, 13/16 in.; 3d, 13/16 in.; thickness throat, 13/16 in.; dome, [illegible]/16 in.; thickness front tube, 9/16 in.; roof, 9/16 in.; thickness side, 9/16 in.; back head, 9/16 in.
Fire Box—Material, basic O. H. steel; depth, front, 73¾ ins.; back, 54¾ ins.; thickness, crown, ⅜ in.; tube, ½ in.; side, ⅜ in.; back, ⅜ in.; water space, front, 5 ins.; side, 5 ins.; back, 3½ ins.
Seams—Horizontal, butt jointed; circumferential, double riveted.
Stay Bolt—Material, wrought iron; dia., 1 in.
Crown Bolts—1 in. diameter.
Boxes—Driving material, cast steel.
Crank Pin—Size, main, 7 x 7 ins.; main side, 7¾ x 5 ins.; front, 5 x 4½ ins.; back, 5 x 5½ ins.
Cylinder—Steam ports, 1⅜ x 20 ins.; exhaust ports, 3 x 20 ins.
Injector—R. and L. Nathan Simplex, size No. 9.
Tender—Weight empty, 54,700 lbs.; wheel base, 17 ft. 1 in.
Valves—Type D-slide; travel, 6 ins.; steam lap, 1 in.; exhaust, 1 in.; lead in full gear, 1/32 in.
Driving Wheel—Tires, held by shrinkage.
Engine Truck Wheels—Kind, c. i. spoke center, 30 ins. dia.
Tender Truck Wheels—Kind, c. i. spoke center, 33 ins. dia.

A Mounted Flagman.

The ordinary railroad flagman is not usually considered to be a very romantic figure, though his duty is always an important one. There are, however, interesting examples of past and present railway flagmen that may possibly be regarded as at least picturesque. The men to whom this description may apply do not trudge along the track silent and alone. They are mounted on horseback and precede a moving train—the chevaliers of the iron trail.

The first railway to carry passengers was the Stocton and Darlington Railway in England, and, speaking of the event, Mr. W. J. Gordon, in a book published in London some years ago, says: "The Stocton and Darlington, which now forms part of the North-Eastern, was opened on September 27th, 1825. The first train consisted of six wagons loaded with flour and coals, then a covered coach containing the directors and their friends, and then twenty-one coal-wagons fitted with temporary seats and crammed with passengers. The engine was 'Locomotive No. 1,' which Stephenson had built, and which he drove. In front of the train went a horseman with a red flag. At a favorable part of the road Stephenson called upon the flagman to get out of the way, and put on the speed, working up to twelve miles an hour and then fifteen. The train reached Darlington in triumph."



FIRST MOUNTED FLAGMAN.
(From "The World's Rail Way.")

This mounted flagman seems to have been part of what was intended to be a railway pageant, for Mr. Samuel Smiles in his work on "George and Robert Stephenson," describes the occurrence as follows: "Strange to say, a man on a horse, carrying a flag, with the motto of the company inscribed on it, *Periculum privatum utilitas publica* (Private risk a public utility), headed the procession! A lithographic view of the great event, published shortly after, duly exhibits the horseman and his flag. It was not thought so dangerous a place after all. The locomotive was only supposed to be able to go at the rate of from four to six miles an hour, and an ordinary horse could easily keep ahead of that."

When the procession started many people ran along beside the engine and a gentleman on horseback who came to look on, galloped beside the train. When Stephenson got up speed, it is needless to say that the runners and the gentleman on horseback were soon left far behind.

Our illustration of the procession is taken from Mr. Smiles' book, which was published by Harper & Brothers of New York in 1868. The other illustration, showing Engine No. 1 of the Stocton and Darlington Railway, the "Locomotion" preceded by the mounted flagman, is from "The World's Rail Way" by J. G. Pangborn, published in 1894.

AT THE YARD, N. Y. C., MOUNTED FLAGMAN WAITING FOR THE DUMMY ENGINE.

Coming down to the present day we are able to present to our readers an example of the mounted flagman, who, although he very often form part of a railroad procession, is not intended for show, nor is his flag inscribed with any motto or badge. In the city of New York a certain amount of switching has to be done every day on the tracks of the New York Central Railroad below Thirtieth street. A dummy engine burning hard coal is used, and as it moves slowly along the streets, notably on Tenth avenue, it is preceded by a man on horseback, carrying a red flag. The mounted flagman is intended to warn "all and sundry" of the approach of the locomotive and cars, and thus the progress is made from the Thirtieth street freight yards to the old New York Central station at Desbrosses street.

At one time the taking away of this privilege was mooted and it appears that the Common Council of the City had under consideration in 1885 a resolution contemplating the termination of the right to use locomotives and dummy engines south of Sixty-fifth street, and referred to a Committee on Law Department the proposed resolution, and in respect of it that committee made report to the Common Council which recites, among other things:

"The Committee on Law Department, to whom was referred the annexed resolution forbidding the use by the New York Central and Hudson River Railroad Company of locomotives or dummy engines south of Sixty-fifth street, and to repeal the resolutions of June 22, 1867, permitting such use, do respectfully report:

"The first regulation of the motor to be used on said railway south of Thirtieth street appears to have been by resolution of the Common Council of December 4, 1850, under which a steam dummy engine was authorized to be run subject to certain conditions to secure the public safety —the speed not to exceed six miles per hour—the machine to be preceded by a man on horseback to give warning of its approach, and 'under such further direction as the Common Council may from time to time prescribe.'"

That majority report bears date December 18, 1885, and was signed by Edward F. O'Dwyer, James T. Van Rensselaer, and Bankson T. Morgan, Committee on Law Department. The railroad in New York thus appears to have instituted the mounted flagman fifty-eight years ago, or just twenty-five years after the Stocton and Darlington flagman on horseback preceded Stephenson on his memorable trip.

OLD PRINT SHOWING MOUNTED FLAGMAN LEADING PROCESSION, AT THE OPENING OF THE STOCTON AND DARLINGTON RAILWAY IN 1825.
(From Samuel Miles' Book on G. and R. Stephenson.)

Car Wheel Flange Failures.

At a recent meeting of the Western Railway Club, Mr. S. P. Bush read an interesting and instructive paper entitled, "The Car Wheel and Its Relation to the Rail and Car." Comparing the wheel loads when cars had a capacity of 24,000 lbs. with those of to-day with 100,000 lbs. capacity, he showed that the total increase which the eight wheels of the larger cars have to carry is 107,600 lbs., or 240 per cent., or 3.3 times as much load. The light car of former days had a cast iron wheel weighing 525 lbs., while the modern car has a 700-lb. cast wheel, an increase of 175 lbs., or 33 per cent. The brake pressure was formerly 12,600 lbs., now it is 30,000 lbs., or an increase of 138 per cent.

N. Y. C. MOUNTED FLAGMAN, A.D. 1908.

It has been suggested, he said, that the cast iron wheel is no longer equal to the conditions imposed by modern service and that a remedy might be found in improved quality of material. While this question of improvement in quality is under consideration, Mr. Bush thought that possibly other developments might be brought about which would greatly mitigate the trouble.

The particular kind of wheel failure that is attracting most attention at the present time is the breaking off of the wheel flange. This is not so frequent as might be supposed, but is a very serious matter and many wheels are removed before this failure takes place. Comparatively few broken flanges come from the flange being worn thin and breaking off laterally through the smallest section at the base of the flange. By far the larger number come as a result of the development of a seam opened on the tread of the wheel, and ofttimes beneath the surface close to the base of the flange and usually before the flange is worn to any considerable extent. Sometimes this seam exists and is not apparent at the surface. In some cases it has existed beneath the surface for some time before reaching it. In most cases examined, it has been noted that the fractured metal had a blue discoloration, which is an indication of oxidization from heat. In stating these facts Mr. Bush said he was confirmed by experienced railway mechanical men and wheel makers.

MOUNTED FLAGMAN PRECEDING N. Y. C. DUMMY ENGINE AND TRAIN, NEAR TENTH AVENUE, NEW YORK.

MOUNTED FLAGMAN AND DUMMY ENGINE WAITING AT A CROSS STREET IN NEW YORK.

The most logical explanation offered appeared to the speaker to be the development of the seam due to heat generated by the action of the brake shoe and that of the flange itself against the rail in conjunction with a heavy concentrated load. Fig. 1 (on the next page) shows a wheel with a tread tapered 25 to 1 resting on the rail. The contact between wheel and rail is reduced to a small area. If the wheel occupies a position such that the flange or the throat of the flange is against the rail the contact will be as in Fig. 2. Frequently heavy loads are carried for some time in this way. There is here an extreme concentration of load at the point of contact, and this is as a rule where the seams develop. At the same time, if a severe brake application occurs, a combination of conditions results which might happen on a curve and grade to a car traveling at considerable speed.

The sudden application of heat to the tread of the wheel at the base of the flange has the effect of making the metal at the surface expand quickly. The metal below the surface cannot expand so quickly and resists the expansion of the surface metal. The surface metal is under compression, while below the surface it is in tension, and the metal will yield at the

THE STREET DUMMY ENGINE AND THE ORDINARY SWITCHER.

weakest section, which is the part under tension. Subsequently if these conditions prevail for a sufficient time the surface will crack. Add to these conditions, brought about by the local application of heat, the concentration of load at the same place with lateral thrust against the flange, and it would seem strange if failures did not occasionally occur.

When the load is concentrated as here described it would seem that a piening action must take place to some extent, probably more with steel than with cast iron.

FIG. 1. RAIL AND WHEEL.

This piening action would seem to have considerable influence in the case of steel wheels, but the chill of cast iron wheels is so hard that the metal cannot flow like steel, but may wear or disintegrate very rapidly if the pressure is extreme.

In referring to Fig. 3 Mr. Bush said, "I desire to lay particular stress on the fact that that part of the fracture which exists at the base of the flange extends vertically for a considerable distance into the tread. If the flange itself was not sufficiently strong to successfully resist the lateral thrust it would seem that the fracture, instead of going vertically down into the tread, would extend transversely across the base of the flange. There are comparatively few cases that have come to my notice where the fracture has been transversely across the base of the flange. In nearly all such cases that I have examined the flanges have been worn thin vertically, and the wheel should not be held responsible."

A number of tests were made at Purdue University by Prof. L. V. Ludy in order to determine the pressure required to remove a piece of flange as if it were in contact with the rail. In all 23 tests were made and it was found that the minimum load was 47,700 lbs.; the maximum was 111,600 lbs.; the average being above 60,000 lbs. A Schoen steel wheel tested at Purdue University with the same apparatus showed a pressure of 526,612 lbs. was necessary to remove a piece of the flange.

Speaking on the subject of lateral thrust Mr. Bush referred to the very interesting publication recently edited by Mr. G. L. Fowler for the Schoen Steel Wheel Co. and the comparisons made therein between steel and cast iron wheels. Mr. Bush, however, does not agree with the opinion that the failure of flanges is primarily and ultimately due to pressure alone. "The evidence," Mr. Bush says, "which I have collected thus far indicates that the number of flanges broken as a result, primarily, of lateral thrust are almost negligible, and that the other causes already described are more likely to be the real ones."

He paid a tribute to Mr. Fowler's careful work and quotes his measurements taken at the outer rail near the end of 1,307 foot radius curve, with an outer rail elevation of 3⅞ inches. At a maximum speed of 30.60 miles per hour the maximum pressure recorded on Mr. Fowler's apparatus was 12,865 lbs., and Mr. Bush says no doubt the lateral thrusts considerably exceed these figures at times.

Continuing, Mr. Bush said, when the new M. C. B. axles were designed a very important item of allowance was made on account of lateral thrust which reached the axle through the wheel. Some railroads had taken this into account and had provided for lateral motion in the trucks. The old swing motion truck provided this,

FIG. 2. CONCENTRATED LOAD.

and some arrangement for yielding resistance would be highly desirable. In concluding this part of his argument Mr. Bush held that if the flanges of cast iron wheels were not sufficiently strong to stand the thrusts of modern service, we would have many more failures than we do. The thickness of the flange has been increased, the limit of wear has been decreased with the idea that more strength might be had, and greater coning of the tread had been recommended and adopted by some for the purpose of keeping the flange as much as possible away from the rail.

The consideration of the coning of the tread was then discussed by Mr. Bush and we hope to present his views in a subsequent article.

A Modest Hero.

The rotary snow plow and snow fenced cuttings have done much to reduce the dangers that enginemen used to encounter in the old "snow bucking" days.

An incident related in one of the early numbers of this journal gives particulars of dreadful endurance and a heroic rescue from death. Engineer Blank was out with a push-plow on a branch where human habitations were far apart. When pushing along at a moderate speed, he struck ice over the rails at a siding, and engine and plow were ditched. The engineer escaped without injury, but after a search he found the fireman insensible under the tank, with one of his legs badly crushed and pinned down by the tank frame. No help was within miles and no train was due for hours.

This ideal engineer proceeded to make the very best of the pitiable plight into which he had fallen. He opened the switches of the siding so that no stray train might run into his wreck, then he proceeded to perform the rescue work. He crawled under the wreck and examined the unconscious fireman. There was no means of raising the tender and the man's leg was crushed into the frozen ground, a shapeless mass. On realizing the condition of affairs the engineer first proceded to kindle a fire for future use. Then he returned to the wounded man and made a tourniquet with the bell rope for the crushed leg, placing it above the knee, cut the flesh with his knife and then sawed through the bone, that being the only means of releasing the unfortunate fireman.

But that did not finish this heroic engineer's human exertions. As the night was bitterly cold he realized that the wounded limb needed warm protection, and having no clothing for aid to the wounded he took off his own shirt and wrapped it around the severed limb. Then he carried the man to the fire and with cushions and clothes made him as comfortable as circumstances would permit. He built a wind break for shelter and dragged in wood from fences and piles of ties. The wounded man was sheltered and cheered until a train arrived

FIG. 3. CRACKS THROUGH FLANGE.

when both the rescuer and the rescued were carried away.

That engineer was so modest that he refused to have his name mentioned when the account of his heroic actions were sent by a friend to LOCOMOTIVE ENGINEERING. The fireman recovered and is now the stationary engineer in the shops.

General Correspondence

The South Manchuria Railway.

Editor:

Some months ago the first steamer of a big fleet specially chartered for the purpose of carrying hundreds of thousands of tons of American rails, locomotives, cars and other railway equipment for the vast network of lines now being built in Manchuria by the Japanese sailed from New York. It came direct to Dalny (now called Tairen by the Japanese), the principal seaboard terminal of the road, called the South Manchuria Railway. This is the first instance of a direct sailing from New York to Tairen.

Forty steamers will be necessary to carry this equipment, which will approximate 400,000 tons, from America. It is estimated that the expenditure for the equipment now under contract will reach $10,000,000; and the undersigned has thought that some notes and photographs from Manchuria and the southern terminal of the South Manchuria Railway would be of interest to the many readers of your valuable journal, a journal that I have enjoyed reading and studying for twenty years and hope to continue that study and interesting reading as many more years by the help of the present organization, your president and co-workers.

Seventy-six of the locomotives are now here and the discharging from the steamers of locomotives, passenger coaches, freight cars, 85-lb. steel rails, railway shop equipment, bridges and other material is going on at a great rate; the same is being discharged into cars alongside the ships and transferred to fields assigned as erecting fields, or yards. So great is the stress, the rush and push that the unloading goes on apace in the dark hours of night, aided by the light of flambeaus and burning debris. Hundreds of Chinese coolies are engaged in the work referred to and their merry song of "heave-to" harmonizes with the wail of countless North Dakota coyotes, and all together the effect seems stage-like and weird. All the executive work is carried on by energetic Japanese. Though many of the coolie class are also here, the bulk of the work is done by Chinese coolies.

THE GREAT WHARF AT TAIREN.

TAIREN CITY BRIDGE OVER THE S. M. RY. TRACKS.

The Japanese "do things" and their organization is excellent. They plan, consider their plans and then execute them seemingly with military precision, and the way they do it is admirable. In the field that they have assigned for the erecting of the two hundred or more locomotives, passenger cars and hundreds of freight cars can be seen two forty-ton steam traveling cranes that span two standard gauge tracks (4 ft. 8½ in.), and ten or more ten and fifteen-ton steam traveling cranes all in operation at the same time, where in this great erecting field are going on the setting up of fifteen or twenty locomotives, as many passenger cars, and whole tracks full of freight cars. In the aggregate the South Manchuria Railway have a herculean task before them; but it will be done, will be done in time and done well.

Tairen is the headquarters of the S. M. Railway and many of the officials live here, among whom is the president, Baron Goto, and a number of the directors. Their buildings are of brick and of pleasing design. The railway company have provided a neat hotel here and the "Occidental" will find in this hostelry all that he has been accustomed to at home. The Yamoto Hotel is a pleasant surprise for many who come to Manchuria.

I take pleasure in enclosing a photograph of this pretty hotel; also a photograph of one of the beautiful streets of this Japanese railroad town, showing on the left (house with cupola) the residence of the president, and at the far end of the street can be seen the S. M. Railway general office building, which street also crosses the beautiful bridge, recently completed, that passes over the S. M. Railway tracks. This bridge is a piece of bridge-

work that would do credit to any city. I also enclose photograph of Tairen's great wharf where all the material and railway equipment will be discharged. Great works and shops will be erected in this city for the maintenance of all the railway equipment of this railway system, and the material for same is now on the ground.

The writer has many personal friends on the railway lines in the States who read RAILWAY AND LOCOMOTIVE ENGINEERING, and he desires to take this means of communicating with them, and will be pleased to again address the editor and them.

W. T. RUPERT.
Traveling Engineer American Locomotive Company.
Tairen, Manchuria.

Reducing Pressure on Old Boilers.

Editor:

Since my early boyhood, when I was taught by my father, for whom I fired, the importance of guarding against excessive pressure on locomotive boilers, I have endeavored to always err on the lines of safety in that respect, if at all. Since holding an official position, which made me feel responsible for anything that did or might occur in the failure of boilers, I have endeavored to learn from some one better equipped than myself a safe and simple method for determining to what extent the pressure on a boiler of a locomotive should be reduced as the age of the boiler increased. Never receiving anything in the way of definite information on the subject, we have worked out in this office what we believe to be quite an original as well as a safe method of regulating the boiler pressure on old locomotive boilers.

THE S. M. RY. HOTEL AT TAIREN

We have assumed for the first fifteen years of the life of a boiler it can safely be concluded that the deterioration in the sheets and rivets, due to age, will not have been sufficient to require, up to that time, any material reduction in pressure, but we have provided that after the boiler has reached that age a reduction in the pressure will be made covering the period the boiler has seen service, and for each year thereafter.

RESIDENCE OF BARON GOTO, PRESIDENT S. M. RY., WITH GENERAL OFFICES AT END OF STREET.

I send you herewith a book, the details of which have been worked out by our mechanical engineer, Mr. J. J. Ewing. The notes which you will find on the first pages of the book will make plain the rule we have adopted for regulating the pressure. It practically means that after fifteen years of service, including the first fifteen years of service, the reduction in pressure will be on the basis of one-half of one per cent. per year.

The rule is as follows: To compensate for possible deterioration of plates and rivets the steam pressure on a boiler should be reduced after fifteen years. The amount of reduction to be determined by the following rule: Multiply the original pressure carried, in pounds, by the number of years of service of the boiler, and this product divided by 200 will give the amount the pressure should be reduced. Example: a boiler twenty years old, the original pressure on which was 150 lbs., would be reduced by the above rule, thus:

$$\frac{150 \times 20}{200} = 15 \text{ lbs.}$$

J. F. WALSH,
S. M. P., Chesapeake & Ohio.
Richmond, Va.

Bronze Truck Plates.

Editor:

I am running an engine that is classed by you as a 2-8-0. Some call them consolidation. The engine truck is the Bissell pattern. The engine weighs 60 tons coal and water, or, in other words, in shape for the road. The 25th day of September, 1905, I had to take out the engine truck wheels on account of them "shelling out." I put in a pair of cast iron wheels which had about 3-16 in. lateral motion. The wheel hubs had no hub-plates of any kind on them. The cast iron wheel hubs and the cast iron truck boxes wore cast iron against cast iron.

The first trip I made I noticed the hubs were very dry and had cut slightly. I then repacked the truck box cellars and the tops of the boxes. I wanted to be sure that they got proper lubrication. But with all the different devices I got up to properly and plentifully oil them they continued to wear and cut the hubs. After running from Sept. 25, 1905, to Dec. 6, 1905, just a little more than two months, making a mileage not to exceed 800 miles, I removed them on account of the lateral motion, which was then 1⅞ in.

I then put in a new pair of cast iron truck wheels with bronze hub plates 1 in. thick. They have been running two years and one month, making a mileage of

22,900. When they were put in the lateral motion was ⅛ in. It is now only ⅜ in., which is proof positive to me that bronze hub plates are the proper thing. There are several 14 deg. curves on the line, which makes the flange wear excessive on an engine which has a 15 ft. rigid wheel base, and of course the boxes have to stand their share of the wear on account of the stiff curves. My object in writing this is that some one may profit by my experience. FRED NIHOOF.

White Sulphur Springs, W. Va.

Crude Oil Welding.

Editor:

I take pleasure in sending you an item for publication which I believe will be in-

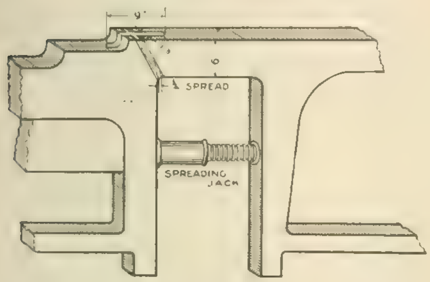
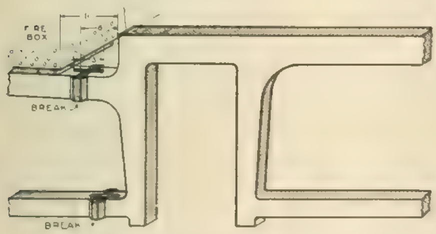


FIG. 1. CRACK OPENED FOR FILLER.

teresting to all your readers:

"We were handed a copy of the proceedings of the fifteenth annual convention of the International Railroad Master Blacksmiths' Association, which was held at Montreal, Canada, August 21-23, '07. We regret very much that our master blacksmith was absent when the welding discussion was in session at this convention, as we believe he could have given some very interesting facts on this subject.

"However, we take pleasure in notifying the public that the Big Four Railroad shops at Bellefontaine, O., is the Father of the 'Crude Oil Weld,' as the first successful crude oil weld was done at that point. Furthermore, we are proud to say



POSITION OF BREAKS IN FRAME.

that many witnesses reported at Bellefontaine shops to receive instructions concerning the Crude Oil Weld, and all were astonished to see the results obtained.

"Our first process was to use one burner, but as we did not get very good results we decided to try two burners and obtained perfect results; and since we have experienced no trouble in welding locomotive frames. Since 1903 we have made 71 successful crude oil welds, with frames on engine, and we take pleasure in submitting a few sketches showing how the frames were prepared before welding. Sketch No. 1 shows how frames are prepared by machinist and sketch No. 2 shows the small brick furnace used in welding frames

"From our experience of welding 71 frames, we can freely say that the Crude Oil Weld is the best weld and just as good as if the frames were removed and taken to the blacksmith shop with less than one-fourth of cost."

(Signed)

F. J. Zerbee, Master Mechanic.

C. H. Voges, General Foreman.

Trusting that the above will meet with your approval, C. H. VOGES, Gen'l Foreman.

Bellefontaine, O.

Curious Flow of Steam Explained.

Editor:

I was quite interested in the article, "Curious Flow of Steam," in your January issue. The first occurrence of this kind I remember was about nine years ago on a Brooks engine on the Cascade division of the G. N. R. R. I was filling the boiler up for the night as we were out on a work train and the watchman was a green man that had been sent out to learn the business. The boiler had numerous leaks, so I filled her up full and just as the injector commenced to take over a little water with the steam, I noticed a spurt of steam from the cylinder cocks and I shut off the injector. I did not know what to make of it and as it did the same thing every night I finally made up my mind to see what it would do if I left the injector on as long as it would put any water into the boiler.

One night I left the injector on after the steam appeared at the cylinder cocks, with the following result. The steam gauge pointer commenced to jump back and forth around the dial of the gauge so fast I thought it would fly off; the injector sputtered, the engine commenced to rock on her springs, the flow at the cylinder cocks changed from steam to water, and finally the injector broke altogether. Then I shut the injector off and set my "think factory" to work. The injector was a Monitor and would work down from 180 lbs. to about 20 lbs., and anywhere from 20 lbs. to 40 lbs. was where I aimed to have the steam by the time I got her filled up for the night.

While the commotion, mentioned above, was going on I was standing with my hand on the throttle and it felt as if somebody was on the inside of the boiler with a mallet, hitting the end of the throttle-stem and trying to drive it out. Now I reasoned like this: We all know that the upper disk of the throttle is larger than the lower one; we know steam is springy and water is solid. My reasoning was then and has ever since been that as the water got up in the dome and commenced to break over into the dry pipe leading to the turret in the cab and then to the injector, the water would jump up and down, striking the bottom disk of the throttle hard enough to unseat it

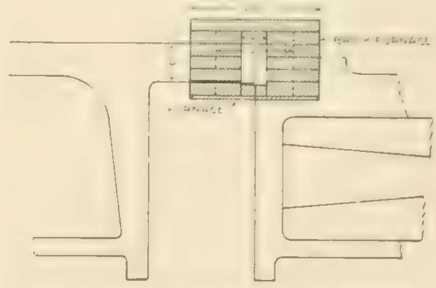
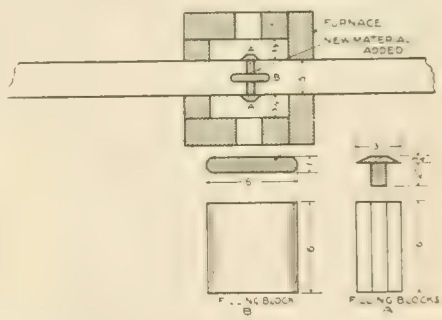


FIG. 2. BRICK FURNACE ON FRAME.

against the springy steam. On account of the larger disk being on top, more steam than water would enter at first, but as the water rose higher more water than steam would enter and finally it was all water and no steam.

The amount of water or steam coming out of the cylinder cocks before the injector would break, depended altogether on how high up in the dome alongside of the throttle-box, the dry pipe to turret was. I afterwards saw inside of the dome of this engine in the round-house at Interbay and the turret dry-pipe was an inch or so above the bottom disk of the throttle. I have had the same thing occur on several different makes of engines since then and with different makes of injec-



PLAN OF FURNACE AND FILLING PIECES.

tors. Any one can try this filling up process and see if they think my theory is right. The jumping of the steam gauge hand is due to the water coming over in the dry pipe to the turret and up into the gauge. The rocking of the engine on her springs is something I have never been able to ferret out. I would like to have other engineers state their views on this subject. HARRY E. SMITH.

Robe, Wash., Canyon Lumber Co.

Never shrink from doing anything which your business calls you to do. The man who is above his business may one day find his business above him.

Lehigh Valley Dynamometer Car Test.

Editor:

I have noticed several articles in your pages during the last few years concerning the building and operating of dynamometer test cars. As I have had considerable experience in that line in the last year I take the liberty of sending you an outline of the policy employed by the Lehigh Valley Railroad in an elaborate test recently made by them. In this test the aim was to get a reliable record of the draw-bar pull, together with the locations, speed, and steam pressure, rather than such minute details as the exact valve travel, the exact amount of water used, the weight of the ashes, and a thousand and one similar details, the exact knowledge of which has very little bearing on the moving of trains in the practical every-day runs. A division of a railroad system is usually subdivided into a number of routes for through freight trains.

There is always a spot on each of these routes where the trains draw harder than at any other point, on the route (in the same direction). If the engine can move the train over this point, then, the engine may usually be depended upon to move the train all the way without trouble. In making a test with a dynamometer car we may locate this point, on the record and divide the tractive effort required to move the train over the hardest pull, by the tonnage of that particular train, and thus obtain a constant, which will be the number of pounds required to pull one ton over the hardest pull at the same speed the train moved over that point in the trip.

This statement may be made more plain, thus:

$$\frac{\text{Tractive effort for train}}{\text{Tonnage of train}} = \text{lbs. per ton.}$$

The proper tonnage rating may then be reckoned, thus:

$$\frac{\text{Tractive effort of engine}}{\text{Pounds required for one ton}} = \text{tonnage}$$

for route and that engine.

We may also check up the tractive effort of the engine by comparing the measured tractive effort with the designed tractive effort, and thus determine the necessary reduction to be made from the mathematical or calculated tractive effort of an engine for this particular route. Of course an engine will not exert as great a draw-bar pull in rounding a curve, as it would be capable of doing on a straight track. Next to be kept in mind during the test, and the subsequent making out reports from same, is the amount of coal consumed by the different classes of engines per unit of power delivered.

The Lehigh Valley tests were made in five months, and covered their entire system. The test referred to above was in charge of the writer.

Sayre, Pa. W. S. Drummond.

Wheel Press Makes Good.

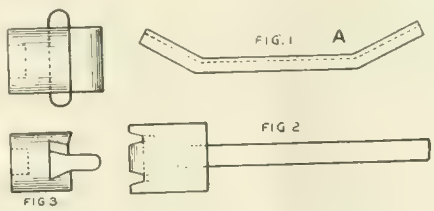
Editor:

Since the introduction of the all steel car there is quite a multitude of channel and I-beams and various other shapes used on these same cars that are exceedingly hard to bend and at the same time keep straight if they are heated. Even when heated and pressed by proper forms in a bulldozer they frequently get out of shape when cooling.

I found this out to my sorrow when I tried it once upon a time and had to rack my brain for some time to provide a method of bending, cold. The pieces were 12-in. channels. We had to keep a gang around the bulldozer with crow bars to skid the machine back on the foundation after having bent a few, cold, on it.

The bars had to be bent as in Fig. 1 and used for truck bolsters, and as we used about 24 of them a day, it was up to me to provide the means for an accurate, safe and economical method of doing the work.

Everything was going at top speed and as the wheel press was idle a good part of the time, I turned my attention to it to



TOOT'S TOOLS FOR WHEEL PRESS.

help me out of a very bad hole, and I must give it credit for the excellent results obtained from its slow and steady power and my happy thought for a form to do the bending.

I got two castings made, one to fit over the ram head and one for the channel, shaped just right, but slightly deeper than the bend at *A*. I took this precaution, for a blow with a sledge would take some of the bend out of the bar if too deep (and we always bent them a little more than needed). If not bent enough they had to be pressed up again. Fig. 2 shows this casting fitted on a scrap axle, which in operation swung in the hooks on the top bar.

The ram casting is shown in Fig. 3 with a heavy steel knife edge keyed in it and the working face rounded nicely so it would not cut the bar. A truck just the right height to keep the bars even, and a gauge to test the bends completed the outfit and—— Well, my troubles were a thing of the past on that job when I got this rig going.

There is plenty of such bending the wheel press can be made to do, if called on, for its slow powerful action is just suited for this kind of work, and the best feature is: you can run it up a foot or a sixteenth of an inch and stop it instantly, which is a feature that no other machine possesses. T. Toot.

St. Louis, Mo.

The Walschaerts Valve Gear.

Editor:

The Walschaerts Valve Gearing is becoming more popular every day, as is witnessed by the large number of locomotives now equipped with the gearing, and to those that are not familiar with this kind of valve motion, it perhaps would be well to know that, unlike the Stephenson shifting link, which has a vertical movement up and down upon the link block, the link with the Walschaerts gear is pivoted at one fixed central point and oscillates freely about that point, but has no vertical movement; and also that the radius rod carries the link block which slides up and down in the link slot.

The radius of the link is from point of connection between radius bar and combination lever, to center of link slot, and the curve of the link is that swept out by this radius.

With the Walschaerts gear, the lead is constant with reverse lever in any position; in other words, hooking up the lever will affect the cut-off, the same as with the Stephenson gear, but will not affect the lead, that always remaining constant.

With the Stephenson gear, lead is obtained by advancing eccentric the amount of the lap and lead ahead of a vertical line drawn at right angles to a horizontal line through center of axle, this advance being called the angular advance, while with the Walschaerts gear, center of eccentric crank pin is placed upon a vertical line drawn at right angles to center line of motion and cannot be advanced from that position. Therefore, there is no angular advance to obtain lead with this gear, but lead is obtained by, and the amount depends upon, leverage in combination lever and crosshead connection.

When it is desired to change the lead or set the valve, the first important move to make is to ascertain the correct length of eccentric rod, which should be of such length that the reverse lever can be moved from full gear forward to full back gear without moving the valve.

Having placed engine upon exact dead center, forward center preferable, and having all parts of gear connected, watch valve while assistant moves reverse lever as before mentioned. If eccentric rod is too long the valve will move back towards link when reverse lever is moved from forward gear to back gear, while if too short, the valve will move away from link.

Having found rod of proper length, or adjusted it to proper length, we proceed to set valve by disconnecting crosshead connection, and, with engine on exact dead center, pull or place the combination

lever in such a position that a vertical line drawn up and down through its exact center would be at right angles to a horizontal line through center of cylinders. The valve should now lap both ports evenly, and will do so if valve rod is of proper length. If not, it must be adjusted to proper length to enable valve to cover ports in central position.

Now move combination lever towards cylinder until valve has moved far enough to give the required lead opening upon that end; crosshead connection should then be adjusted to proper length to hold combination lever in this position.

Having obtained the required lead in this way, and having all connections properly made, engine should be moved over upon exact back center and lead opening observed upon that end. If the various parts of the gearing are properly designed and connected there should be but a very little variation between the lead upon this end and the other; yet if any difference exists, it can be equalized by lengthening or shortening valve spindle. Having adjusted this side properly, proceed the same way with the other side.

When necessary to disconnect on account of broken cylinder head or from any other cause while on the road, simply removing or disconnecting eccentric rod, or radius rod, upon that side renders the valve inoperative. Crosshead and valve can then be blocked in position to go in on one side, or main rod can be left up and that side rendered inoperative by disconnecting or taking down eccentric rod and crosshead connection, placing valve to cover ports and fastening combination lever in such a position that crosshead will clear.

With broken reach rod, engine can be worked ahead with full train by blocking link block down in lower end of link slot. Do the same with broken reversing shaft, arms, or lifting link.

If any of the different parts of the gear itself should become broken while on the road it would render that side inoperative, in which case it would be necessary to disconnect or take down eccentric rod and crosshead connection and place valve to cover ports, care being taken to see that crosshead will not strike combination lever while in this position.

It should be noted here that these directions all apply to the Walschaerts gear when this gear is so applied that the eccentric pin precedes main crank pin in go-ahead gear, but when, as is sometimes the case, this valve gear is so applied that the eccentric pin follows main crank pin in forward motion, the movements of the valve to be observed when testing length of eccentric rod would be the opposite of those referred to in this article, and blocking of link-block would be in opposite end of link slot. Some of the large engines have the link so placed that the point of connection between eccentric rod and lower end of link is upon a horizontal plane considerably above that of the cylinders, in which case the eccentric crank pin is so placed upon the wheel that it is at right angles to a line drawn from center of main axle to center of point of connection between eccentric rod and link, but this does not require any changes from the method used in setting valves.

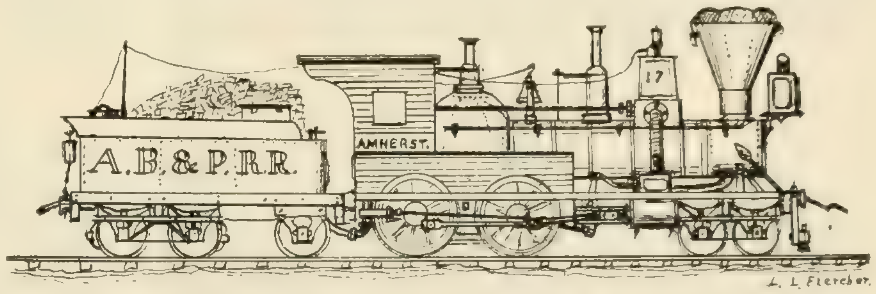
E. C. ALLEN.

West Stockbridge, Mass.

Old Timer on the A. B. & P.

Editor:

Being a constant reader of your paper and seeing many queer cuts of old locomotives, I have enclosed a sketch of one. I don't remember seeing anything like it in your paper. In about the year 1862 this engine made its appearance on the Concord, Manchester & Lawrence Railroad. I first saw it on the pay-car and seldom saw it on anything else. The sketch is not made to scale, but just as I remember seeing it the last time, as it was standing on the siding at Salem, N. H. It had only run six miles since taking on wood and the tender was piled high with the same.



OLD TIME ENGINE ON THE A. B. & P. RAILROAD.

Notice the cylinder on a line vertically with the dome; there was no saddle to hold the forward end of the boiler. The latter was kept in place by several braces and the centre plate for the forward truck was also held by trussing and bracing, also the frames between the cylinders were reinforced by bracing. The outside steam pipes were covered or wound, which made them look out of proportion. You will notice the main rods were very short, which must have been hard on the guides. I am not sure about the half-stroke pump nor all the fittings on the boiler, nor about it having a six-wheeled tender, for it is forty-six years since I last saw it, but the sketch will be recognized by any of the old-timers that were on the Concord road at that time.

Notice the throttle lever at the base of the dome, with rod reaching back to the cab and connecting with the hand lever for the same.

What I would like to know is why was the Concord Co. using that engine, which I always calculated was designed for the Amherst, Belchester and Palmer Railroad at that time, for they lent some of their own to the Vermont Central about that time. They also had one other of the same type, which I have been told was the same engine, but I have my doubts. It was called Hooksett. I would like to hear in regard to it from some one that knows. I have been informed that several engines of that style were designed and built on the company's brands by a man named Thompson, then agent of the Essex Machine Shop at Lawrence, Mass. They had to dispose of the engines for "most any old price" and it was the main cause of closing the works permanently.

L. L. FLETCHER.

West Buxton, Me.

Defects of Steel Tires.

Editor:

With pleasure I have read your editorial in the January issue on "The Defects of Steel Tires." I may say that I have found the conditions exactly as you describe and have been quite a little vexed at the frequency of defective treads caused by shelled spots. I have also noticed in turning off tender wheels that defects would develop under the cut which were not noticeable on removal. I also note on page 35 a series of investigations by Mr. George L. Fowler on the car wheel, and which has impressed me very much. Speaking of indentation by the cast-iron wheel and the compression of both the steel wheel and the rail, brings me to the point of this correspondence.

In recent years and since the frequent application of steel wheels the accidents from derailment of tenders have been on the increase. These have not been confined to any special locality or design, and the reasons for the same have not always been satisfactorily explained. Would these peculiarities of the two wheels be affected by the lateral thrust or by increased frictional resistance on the curve have a greater tendency to derailment? I would be pleased to hear some expressions of opinions on this subject.

WILLIAM S. GRAY.
General Foreman L. & N. R. R.
Covington, Ky.

[The article referred to by our correspondent was based on the paper recently read by Mr. G. L. Norris, and a synopsis can be found on page 16 of our January issue. The paper has been reprinted in full by the Standard Steel Works of Philadelphia and a copy of it may be had by

applying to them for one. The illustrations used in this reproduction are, as we said last month on page 127, the very best, and the article is well worth study.—Ed.]

Pleasant and Instructive Meeting.

Editor:

A special meeting of the Catawissa Air Brake Club was held Thursday evening, Feb. 27, 1908, at Catawissa, Pa., Mr. James Cook, president. Mr. F. H. Whitney, of New York City, one of the Westinghouse Air Brake Company's representatives, gave the club a very instructive and interesting talk on the air brake in general, from the three-way cock and plain triple up to the present time. There were thirty-nine members present at the meeting and everyone was very much benefited by his address and would be very glad to have him visit us at any time.

Paul R. Henry, Secretary.

Catawissa, Pa.

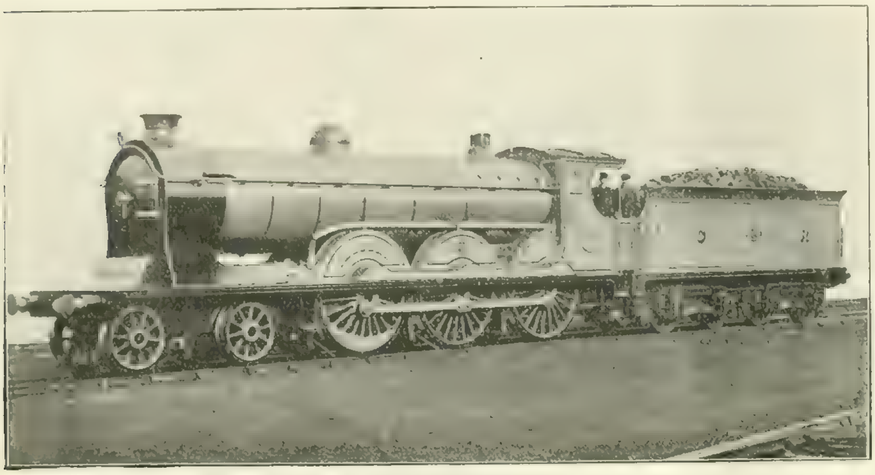
Air Brake Leaks.

Editor:

I have read the letter written by Mr. McDougal, which was published in the general correspondence columns of the March issue of Railway and Locomotive Engineering, and I would like to repeat a portion of the article in the January number which your correspondent refers to.

"If the automatic brake leaks off with the valve handle on lap there must be a leak in the application chamber or the pipe connections. If the independent brake leaks off when the handle is placed on lap the leak is usually past the valve seat of the safety valve. If the brake cylinder and pipe connections are tight the distributing valve will exhaust the brake cylinder pressure as the application chamber pressure reduces, but if the brake cylinder leaks can reduce the pressure as fast, or faster than the application chamber pressure reduces, the brake will leak off without giving any warning."

It was at this time considered unnecessary to state that under ordinary conditions, if a leak existed in the application chamber of the distributing valves, the brake cylinder pressure remaining constant would force the main piston to release position as the application chamber pressure weakened, and the exhaust of brake cylinder pressure from the distributing valve would warn anyone working about or oiling the engine that the brake has released.



CALEDONIAN RAILWAY HEAVY 4-6-0 ENGINE.

It was left to the reader to infer that in order to avoid the possibility of the brake releasing from a leak of this kind the handle of the independent brake valve should be allowed to remain in application position, especially when the engine is standing on a graded track or if the throttle is leaking.

But it was intended to state that with leakage in both pressures and the valve handle on lap position the distributing valve would give no warning that the brake was releasing, if the leakage in pounds per minute from the brake cylinder was equal to or in excess of the leakage from the application chamber.

In explaining the movement of the hand on the air gauge Mr. McDougal shows that he is an air brake man who gives some attention to the cause and effect of unusual action of the brake and, as he states, the rising and falling of the hand on the brake cylinder gauge under the conditions mentioned is usually due to brake cylinder leakage, and the main piston of the distributing valve not working freely. Sometimes it is due to leakage in the application chamber or in the signal system in conjunction with a reducing valve that does not open promptly and supply the leakage. There is sometimes a difference of opinion as to what is to be considered as a warning. When the automatic brake valve handle is in release the position of the hands on the air gauge indicate that main reservoir pressure is flowing directly into the brake pipe, but the escape of air from the brake valve warning port is relied upon to attract the engineer's attention to the fact.

I have also noticed Mr. Clegg's criticism of an article which appeared in the Air Brake Department of the February issue of this journal and wish to call his attention to the fourth paragraph of the article.

"No matter how necessary or desirable it is to remove a triple valve for cleaning or testing, there are certain times in almost every engine house when this cannot be done owing to the short space of time the engine is to remain in the house and to the lack of

4-6-0 TYPE ON THE GREAT WESTERN RAILWAY.

material to make the change, and whenever it is necessary to clean the triple valve without removing it a competent man should do the work."

Washington, D. C. G. W. KIEHM.

Hollow Wedge Bolt.

Editor:

I note in the March number of RAILWAY AND LOCOMOTIVE ENGINEERING, page 127, that Mr. J. A. Monfee, master mechanic of the Birmingham & Southern Railway at Pratt City, Ala., is using a hollow wedge bolt with excellent results. Relative to this bolt I desire to state that some three or four years ago I designed a bolt absolutely like this, except that the wedge bolt proper was ⅞ ins. in diameter; the use of such a bolt prevents breaking of bolts and holds the wedge always in place. Quite a number of them were applied and they gave excellent results. There is a foreman in the Southern shops at Birmingham, Ala., by the name of V. H. Winnberg, who no doubt will remember the circumstance. So far as known there is no patent on this device and all railroads can use same if they so desire and they will find it a good investment. If you deem proper you can publish this letter.

St. Louis, Mo. L. BARTLETT.

Newest Things in the Oldest City.

Damascus, whose pedigree is the longest of living cities, is losing its character. An enterprising Belgian company is cutting through it with an electric tramway, and is sprinkling electric lights in its ancient streets. What is more, the motive power for these installations is derived from the harnessing of the river falls twenty-two miles off, so that no feature of the modern invasion is spared the place whence the Jew of Tarsus escaped in a basket over the wall. The British acting-consul reports that three and a half miles of the tram line are already laid, and one wonders if "the street which is called Straight" affords an avenue for the line. Meanwhile it is of further interest to note that traffic on the Hejaz Railway, which some day may reach Mecca, finds a convenient entrepot in the old-time emporium of the slow-moving caravan.

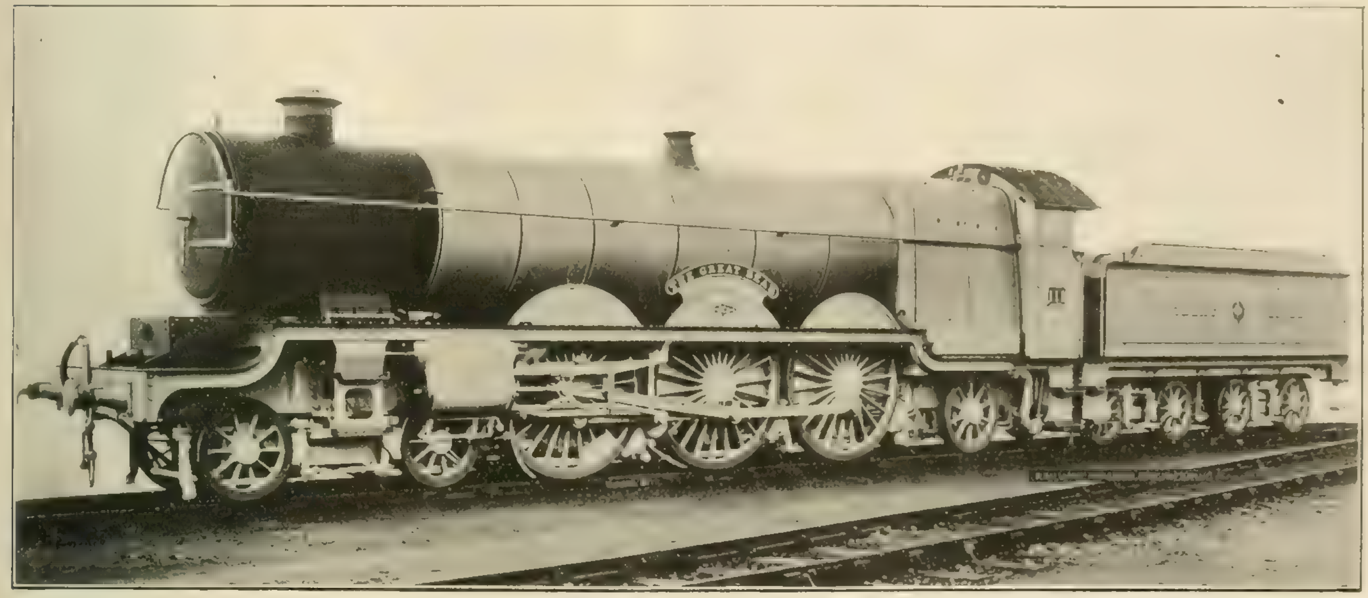
Pacific Type in Great Britain.

The first Pacific type engine constructed for service in Great Britain has just been completed at the Swindon Works of the Great Western Railway from the designs of Mr. G. J. Churchward, the locomotive superintendent of that road.

In working order, the engine weighs 97 tons 5 cwt., and the tender (full) 45 tons 15 cwt., giving a total weight on rails of 143 tons, these are long tons thus showing "The Great Bear" to be much the heaviest locomotive on any British railway. The Caledonian Railway has hitherto possessed the heaviest engines in Great Britain, one of which, the "Cardean," is illustrated. In 1905 this company built two locomotives, each weighing 123 tons, and a year later built a 4-6-0 locomotive having an aggregate weight of 130 tons. The Great Western 4-6-2 type engine, therefore, exceeds it in weight by 13 tons; the engine itself weighing 24 tons 5 cwt. more, and the tender 11 tons 5 cwt. less. The latter difference is accounted for by the fact that the Great Western Railway tender is fitted with water pick-up apparatus, whilst the Caledonian carries sufficient water for the entire run.

"The Great Bear" is somewhat similar in dimensions to the recent ten-wheel locomotives on the Great Western Railway, of which we give an illustration; but the introduction of a pair of trailing wheels in the design of "The Great Bear" has enabled the size of the firebox to be increased and the boiler to be lengthened considerably. The boiler barrel is 23 ft. long and 6 ft. outside diameter, being 8 ft. 2 ins. longer and 6 ins. larger in circumference than the ten-wheelers. The engine wheel base is 34 ft. 6 ins., and that of the tender is 17 ft.; the rigid wheel base of the engine has been reduced from the 14 ft. 9 ins. to 14 ft. The total wheel base of engine and tender is 61 ft. 0½ ins., and the total length over all 71 ft. 2¼ ins.

The four cylinders are all high pressure, having a diameter of 15 ins. and stroke of 26 ins. The boiler is of the Belpaire pattern, having a wide firebox, and is fitted with a superheater. The heating surface totals 3,400.81 sq. ft., 158.14 sq. ft., of which is supplied by the firebox, 2,673.45 sq. ft. by the tubes, 24.22 sq. ft. by the arch tubes, and 545.00 sq. ft. by the superheater tubes. The grate area is 41.97 sq. ft. The working pressure, 224 lbs. per sq. in., and the tractive effort is about 29,430 lbs. The driving wheels are 6 ft. 8½ ins. in diameter, the bogie wheels 3 ft. 2 ins., and the traling 3 ft. 8 ins. The tender carries 3,500 Imperial gallons of water.



FIRST 4-6-2 ENGINE IN GREAT BRITAIN—GREAT WESTERN RAILWAY.

Yucatan of Central American, located on a peninsula running into the Gulf of Mexico, is little known to Americans, which is to be regretted, for the country has been making decided progress during the last decade, and is offering a market for machinery and for equipment of narrow gauge railways. Our railroad supply houses that find business depressed might profit themselves by establishing correspondence with merchants of Yucatan.

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Car Inspection Based on Mileage.

Some years ago when the system of car interchange among railways had become very cumbersome, there arose a desire for what was termed "inspection for safety only" in contradistinction to the then existing method of inspecting cars principally for the purpose of "record." The "record" inspection took note of any equipment or repair work which was not according to the standards of the owning company. The inspection for safety only, greatly simplified the work of car inspectors and repair men and concentrated attention on matters which were vital.

A modification of this form of inspection for safety has been in vogue on the Interborough Rapid Transit Railway in New York for more than a year. The system of inspection adopted on the elevated and subway divisions is inspection for safety only, but it is based on the miles run by each car rather than upon the number of times a car happens to come within reach of a car inspector. The system therefore tends to produce uniformity, in the sense that each car comes in for a systematic "look-over" after it has done a certain amount of work, represented by the miles run.

The inspection of cars on the basis of mileage made, is over and above and a thing apart from the regular inspection which a car receives at each end of a round trip. The round trip inspection is for the purpose of making such minor repairs as will keep the car constantly on the road or promptly take it out of service when necessary.

The mileage basis inspection as arranged on the Interborough system is very ingenious and has been evolved by Mr. Frank Hedley, the general manager, Mr. S. D. Smith, superintendent of the elevated road, and Mr. J. S. Doyle, superintendent of car equipment. The mileage records are very closely kept and after a car has made a predetermined mileage, it is placed on the list of shop cars. This predetermined mileage, as it were, establishes a car's right to a thorough inspection in the shop. If owing to the requirements of traffic or for other reasons a car cannot be sent to the shop on the completion of its mileage it is allowed to make a few more trips, at the end of any one of which it may be turned in for inspection. These few trips constitute what we may here call the "marginal mileage." The lower limit of this margin is the minimum and the upper limit is the maximum mileage. No car is allowed to run after the maximum limit is reached. Cars having made maximum mileage must be sent to the shop without question or delay.

It is thus evident that cars having made the minimum mileage are eligible for the shop and the small marginal mileage allowed in addition is for the purpose of always having a supply of cars sufficient to keep the shop full. The output of the shop is thus on the average kept constant, and there is no incentive to make a record for anything but efficiency. The marginal mileage principal allows for fluctuations of traffic, and also, if one may so say, prevents the slack of the road running into the shop with a shock. Any slight fluctuation in shop output is also taken care of by the marginal mileage. The Interborough being an electrically operated road, the predetermined mileage of a motor car is the standard, with its minimum and maximum. Trailer cars are allowed to make one-third more miles than the minimum of the motor cars, and their maximum is one-third more mileage than the motor car maximum.

This system has the advantage of vitally concerning both the operating and the mechanical departments. A subordinate in the superintendent's office makes a daily abstract from the mileage sheets, of all cars having reached the minimum, and this list is handed to the man concerned in delivering cars to the shop. When the maximum is reached by any car its number is marked with a cross and the delivery of the car to the shop becomes obligatory.

A work book similar to that used in a round house is kept at the terminal and notations are made in it as need be, at the end of each trip. This book remains a day at the terminal and is then taken to the shop and is replaced at the terminal by another book. These books alternate each day between terminal and shop. When a car arrives at the shop, any work booked against it is written on a card and this card is hung on the truss rod or other convenient place. The card contains also space for specific items such as brake inspection, and electrical equipment repair. These regular items are printed. This card is filled in by the men appointed to do the various kinds of inspection and repair work, and when turned in, form the basis of the repair record.

The system of inspection here outlined has resulted in a large saving to the Interborough, as it enables the company to maintain a pretty constant average of cars passing through the shop. The staff required has been proportioned to the work, which under this system practically remains constant. The efforts of the staff are also concentrated upon only those cars which require attention and are not consumed in the needlessly repeated inspection of some cars, to the disregard of others. The staff is never idle waiting for cars to come in. Each car in service is constantly adding to its mileage and is thus constantly approaching the inspection point. The process is as steady as the flow of water from a spring. As particles of water rise in the basin of rock to a certain level and, with perhaps an eddy or two, flow off; so one may say the cars reach the inspection level and, though they may be held briefly by the margin of mileage allowed, they all find their way surely to the repair track before being put in service again.

Fitting the Rod Brasses.

In marine engineering the care of the rods connecting the cross-heads of the engines with the cranks is a subject of unceasing anxiety to the skilled engineers, who seem never to take their eyes off the ponderous bearings. In locomotive engineering there are such an infinite variety of other things to attend to, that the rods generally are allowed to look after themselves until some mysterious thump starts in its gradually increasing vehemence to call attention to some loosening joint. The cold water cure and a few blows of a pitiless hammer, and a few drops of cheap oil poured out with a frugal hand,

and away they go again in a desperate effort to make up for lost time.

Locomotives engineers generally do their very best to keep the rods in proper adjustment. The same cannot always be said of the machinist who fitted the brasses or the constucting engineer who designed the rods. Rod straps are often lighter than they should be. Parts of the locomotive that are as immovable as the fixed stars are heavy as blacksmiths' anvils, while some moving parts subjected to great and incessant shocks approach flexibility in structural weakness. The thickness of the rod straps is an important factor. The tendency to wear and widen at the point where the brasses meet is very great. This point is unnecessarily weakened by drilling large holes to admit the stems of the oil cups. A good plan to strengthen the strap is to increase its thickness at the part where the brasses are located. If the increase is toward the inside it has an important advantage from the fact that as the inevitable wear begins to affect the inner face of the strap, it can be straightened by carefully filing away the unworn portion. This can be repeated, avoiding the tedious operation of closing the crown of the strap as is usually done by a rough and ready process in the blacksmith's shop.

Closing the strap at the crown has several serious drawbacks. It naturally leads to a tapering of the inner face of the strap, involving much work in refitting on the butt end of the rod, and while a slight taper may be an advantage in getting a good fit of the brasses, the advantage is more apparent than real. The brasses may fit well in the taper strap, but the necessity invariably arises to add liners between the bottom brass and the crown of the strap, in which case, the brass being moved from its original position, it will be found that the imaginary advantage of the taper becomes a detriment and the brass is soon rattling, loosely, in the strap and producing an indentation in the region of the oil hole.

The increase in the thickness of the straps at the brass bearing point necessarily involves an increase of the dimensions of the butt end of the rod to make up for the desired increment, but it will be found that the matter of one-eighth of an inch does not add materially to the weight, while it almost entirely excludes the necessity of ever sending the rod and strap to the blacksmith's shop. This, of course, is part of the constructing engineer's or master mechanic's work. When it comes to the fitting of the strap on the rod, and the fitting of the brass in the strap, it may be said in a general way that the less tapering work there is the better. It should be particularly noted that the brass fits exactly on the bottom of the strap. The least tendency to rest heavily on one corner or on the centre of the strap has the most pernicious effect in a rapid loosening of the brass. Lathe hands should also leave as much of the brass as possible on the sides or flanges of the brasses. The method, much in vogue, of leaving a ring of brass about the same size as the flange of the crankpin and reducing the remainder of the side of the brass to a thin flange is a bad one. In a short time the brasses necessarily are closing together, and the crankpin flange begins overlapping the brasses at the front and back ends. The thin brass flange soon loosens and when side play has begun in the strap the days of the brasses are numbered.

There are several clever methods of patching brasses, but it will be found that soldered strips to the sides and outer bearings of brasses do not greatly prolong their lives. The tangental hammer blows of the flying crank pins soon get their fierce work in on the soft soldered patches and the clanging of the loose joints rattles wofully to the tune of a false economy that is dear in the end.

It is gratifying to note that the rod bearings are showing a tendency to a greater degree of massiveness of construction in many of the recently built locomotives. This is a step in the right direction, and it is particularly the case with the designs of main rods. Properly supplemented by careful fitting, and supervision in service, the results are being found to meet in a larger degree of efficiency the growing requirements of the locomotive engineering service.

Weathering and Deterioration of Coal.

The weathering of coal is the name given to the loss of heat-producing value which takes place when coal is stored in large quantities for industrial purposes, usually in large piles or in bins in the open air. The deterioration of coal is the somewhat similar losses which take place when coal is contained in air-tight cases and exposed to the diffused light of day.

Some interesting conclusions regarding these sources of loss in Illinois coals have been published in bulletin No. 17 of the University of Illinois. The experiments on the weathering of coal have been conducted by S. W. Parr, professor of applied chemistry in the University, and by Mr. N. D. Hamilton, fellow in chemistry. The examination of coal samples in order to determine the deterioration was done by Prof. Parr and Mr. W. F. Wheeler, assistant chemist of the Illinois State Geological Survey.

The summary of results obtained in connection with the weathering of coal states that submerged coal does not lose appreciably in heat value. In this connection we may say that an article on "Under Water Coal Storage," was published in the April, 1907, issue of RAILWAY AND LOCOMOTIVE ENGINEERING, page 174. In this article we gave the procedure adopted by the Western Electric Company for the submerged storage of coal in concrete bins. The summary by the university also states that outdoor exposure results in a loss of heating value varying from 2 to 10 per cent. Dry storage has no advantage over storage in the open except with high sulphur coals where the disintegrating effect of sulphur in the process of oxidation facilitates the escape of hydrocarbons or the oxidation of the same. In most cases the losses in storage appear to be complete at the end of five months. From the seventh to the ninth month the loss is inappreciable. The results obtained in small samples are to be considered as an index of the changes affecting large masses in kind rather than in degree, but since the losses here shown (Bulletin No 17) are not beyond what seem to conform in a general way to the experience of users of coal from large storage heaps, it may not be without value as an indication of weathering effects in actual practice

In the matter of the deterioration of coal the bulletin states that an exudation of combustible gases from coal occurs from the time of breaking out the sample from the vein. That an absorption of oxygen accompanies the exudation of hydrocarbons. Samples of coal in most carefully sealed containers are subject to deterioration. The process of deterioration is probably due to oxidation of hydrogen or hydrocarbons by means of the absorbed oxygen. It may also be due to a simple loss of combustible gases and the replacement of the same by non-combustible gases such as oxygen. The rapidity or extent of this deterioration varies with different coals, but it is probably most active during the first two or three weeks from the taking of the sample, but does not seem to reach a normal state till after a few months have elapsed. Further data on this point especially are necessary.

Assigned and Pooled Engines.

In a paper presented to the Central Railroad Club by Mr. John A. Talty, he made the following highly sensible points on power assigned regularly and power pooled. He said:

I have in mind a road that regularly assigns the power. During the month of January, 1908, they ran 465 slow freight trains over a division 141 miles in length. The average time east was 9 hours 45 minutes and the average time west 9 hours 22 minutes. The fast and manifest trains numbered 266, with an average of 6 hours 36 minutes east and 6 hours 18 minutes west. With the exception of a few days summer tonnage was hauled. This, in my opinion, is a very remarkable performance and can only be brought about by regularly assigning the power

and holding each engineman responsible for the condition of the locomotive as far as his responsibility extends.

On a modern railroad, where it is necessary to pool high pressure power, the mechanical officials are up against a hard proposition in mantaining the same; thus giving the transportation department 100 per cent. proficiency, for the reason that with the exception of casualties to engines the responsibility cannot be placed upon the shoulders of the enginemen and they in turn grow neglectful or careless with only one view in sight, and that is to complete the trip. They do not inspect the engines on arrival, neither make a proper work report, which in a short period results in decreasing the mileage between shopping to locomotives as well as increases the engine failures, which the mechanical officials are compelled to explain.

I know of cases where power has been regularly assigned and where men have made 4,000 miles per month and the average miles per engine, in slow freight, was 4,500 miles per month for each engine in the service. I doubt very much if this can be duplicated where the pooling system is in vogue.

Steam and Electric Lines.

In addressing the New England Railroad Club at one of its recent meetings, Mr. L. S. Storrs, when speaking on the "Relation between Steam and Electric Lines" said there may be a feeling of protest in the minds of many against any attempt to show a connection, even the most remote, between the steam railroad and the trolley line. Trolley properties have been developed from the horse-car instead of looking ahead and taking advantage of the knowledge obtained from the development of steam roads during the last twenty years. Steam railroad experience is, however, now being made use of, but it has been preceded by a somewhat costly process, having the horse-car as a starting point.

Trolley lines, he said, may be divided into several classes. First there is the urban line as seen in large cities, which is intended solely for the distribution of the residents of a city to and from their various places of business, and in this no resemblance to a steam railroad can be traced. Second, comes the high-speed inter-urban line, built with the primary intention of connecting two cities by the shortest possible route. This class resembles a steam road in that quickness of service is aimed at, resulting in the elimination of curves, keeping down grades, and the straightest route is followed without including intermediate points if requiring any deviation of line. The third class is that of trolley lines which serve villages more or less remote from the steam lines. These lines follow the greatest density of population and do not aim at rapid service, but are for the convenience of the whole community.

One of the ways in which trolley development may help steam roads is in the relief afforded by hastening the loading and unloading of merchandise. To the trolley express car will be transferred the small shipment destined for a rural community. This permits steam railroad cars to be used for other purposes and relieves congestion on sidings. There is another side to the question, which is of more immediate value to steam lines, namely, in assisting in the distribution of freight to small villages. This relieves the steam road of the unprofitable and slow delivery of small shipments to country places. The trolley does not have to hold freight to make up a heavier shipment. Warehouse congestion will be relieved and the box car becomes available for more lucrative loading and its average mileage will be increased.

There is, he maintained, another side to trolley development, which has just begun; that is the electrification of lateral steam lines, whereby trolleys can do the local service and leave the steam roads the through traffic. Where this is done the steam line has been able to economize by taking off all local service, thus rendering its equipment available for more important service The trolley gets a revenue formerly unavailable. The community is better off, having hourly service instead of perhaps four trains a day. This is an indication of the value of the trolley as an auxiliary to the steam road for the further development of older settled portions of the country.

Another phase, according to Mr. Storrs, of the development of steam and electric lines is found in suburban travel. Suburban towns can be better served locally by electric lines than by railroads. It is the delay in passing through the congested streets of a large city which makes suburban traffic by electric lines unsatisfactory. The solution of this problem is the electrification of the terminal portion of the steam line and making connections with the trolley a short distance from the city, thus bringing the electric car into the city over existing railroad tracks. Such a plan admits of more frequent and flexible suburban service, distributes passengers more quickly to their dwellings in the suburbs, eliminates the smoke nuisance and is a general improvement. In brief, the trolley can be made to relieve to a limited extent the congestion of main steam lines by taking from them a portion of the local merchandise traffic and some of the suburban and local interurban passenger traffic. The chief part to be played by the trolley as an ally of the steam road is in the development of tributary territory and in acting as collecting and distributing agents throughout rural communities.

Facts About Alcohol as Fuel.

About two years ago there was a great deal of agitation calling for the abolition of taxes on alcohol used for industrial purposes, the allegation being made that the American farmer, the fondling and laughing-stock of politicians, would profit greatly by converting products of the farm into alcohol. The law was changed, practically putting alcohol for industrial purposes upon the free list, but the farmers have not responded much to the call for converting waste products into alcohol. That part of the movement has failed.

But the United States Department of Agriculture engaged certain engineers to make tests of internal combustion engines to show the relative efficiency of alcohol and all the various hydrocarbons as fuel, which has brought out information that will be valuable to many departments of engineering. Among the experts engaged to make tests was Professor C. E. Lucke of Columbia University, who carried on a series of most exhaustive experiments. The report submitted by Professor Lucke, which can be obtained on application to the United States Agricultural Department, ought to be studied by every person interested in internal combustion engines. The conclusions of the report are:

(1) Any gasoline engine of the ordinary types can be run on alcohol fuel without any material change in the construction of the engine. The only difficulties likely to be encountered are in starting and in supplying a sufficient quantity of fuel, a quantity which must be considerably greater than the quantity of gasoline required.

(2) When an engine is run on alcohol its operation is more noiseless than when run on gasoline, its maximum power is usually materially higher than it is on gasoline and there is no danger of any injurious hammering with alcohol such as may occur with gasoline.

(3) For automobile air-cooled engines alcohol seems to be especially adapted as a fuel, since the temperature of the engine cylinder may rise much higher before auto-ignition takes place than is possible with gasoline fuel; and if auto-ignition of the alcohol fuel does occur no injurious hammering can result.

(4) The consumption of fuel in pounds per brake horsepower, whether the fuel is gasoline or alcohol, depends chiefly upon the horsepower at which the engine is being run and upon the setting of the fuel supply valve. It is easily possible for the fuel consumption per horsepower hour to be increased to double the best value, either by running the engine on a load below its full power or by a poor setting of the fuel supply valve.

(5) These investigations also showed that the fuel consumption was affected by

the time of ignition, by the speed, and by the initial compression of the fuel charge. No tests were made to determine the maximum possible change in fuel consumption that could be produced by changing the time of ignition, but when near the best fuel consumption it was shown to be important to have an early ignition. So far as tested the alcohol fuel consumption was better at low than at high speeds. So far as investigated, increasing the initial compression from 70 to 125 pounds produced only a very slight improvement in the consumption of alcohol.

(6) It is probable that for any given engine the fuel consumption is also affected by the quantity and temperature of cooling water used and the nature of the cooling system, by the type of ignition apparatus, by the quantity and quality of lubricating oil, by the temperature and humidity of the atmosphere, and by the initial temperature of the fuel.

(7) It seems probable that all well-constructed engines of the same size will have approximately the same fuel consumption when working under the most advantageous conditions.

(8) With any good small stationary engine as small a fuel consumption as 0.70 pound of gasoline or 1.16 pounds of alcohol per brake horsepower hour may reasonably be expected under favorable conditions. These values correspond to 0.118 and 0.170 gallon respectively, or 0.95 pint of gasoline and 1.36 pints of alcohol. Based on the high calorific values of 21,120 British thermal units per pound of gasoline and 11,880 per pound of alcohol, these consumptions represent thermal efficiencies of 17.2 per cent. for gasoline and 18.5 per cent. for alcohol.

But calculated on the basis of the low calorific values of 19,660 British thermal units per pound for gasoline and 10,620 for alcohol, the thermal efficiencies become 18.5 for the former fuel and 20.7 for alcohol. The ratio of the high calorific values used above is, gasoline to alcohol, 1.78. The corresponding ratio of the low calorific values is 1.85. The ratio of the consumptions mentioned above is, alcohol to gasoline, 1,66 by weight, or 1.44 volume.

Sensible Advice to Firemen.

Firemen, like other human beings, sometimes become dissatisfied with their lot and with their prospects. A discontented young fireman having written to the old Locomotive Engineer, asking if it was any use remaining on a road where promotion was strictly awarded to the oldest fireman, received the following fatherly advice from John A. Hill:

It would be better to remain at home, there can be no doubt. Take a trip next summer, study the engines and men in other parts of the country, and you will come home better satisfied with your own lot. Keep up your reading and study your business—it will become useful to you when you least expect it. Study your business from your own standpoint, observe closely, and above all, be so busy that you will not have time to think of those years yet to fire. Do your work well on the road and keep your engine clean. Be conspicuously useful to your engineer and to the officers of your department. You will be promoted because you are a good fireman, not because you are a good engineer.

Watch your work and chances to improve yourself, and do not think of the results. Somebody else will be watching you. Do not put your nose to the grindstone, but take a certain amount of enjoyment. Select your pleasure as you do your clothes. It will pay better to spend $2.00 to see a good play than 25 cents to see a low variety show. Buy books, not all mechanical, but good, wholesome story books, entertaining and instructive. If a fine painting is on exhibition in town, take it in and let the circus go. Seek the companies of ladies, and avoid that of mere females. Take needed rest as soon as you come in, and be ready to go in an emergency, and thus establish a good reputation at the roundhouse. Promote discussion on locomotive subjects among fellow firemen, and thus inform yourself and establish a reputation as an intelligent engineman among a class you will work with.

If you have a room, make it a home; have a fire in it, have books, pictures, magazines, and you will soon come to seek the comforts and enjoyments of that room rather than the streets. Your life, your conduct, your abilities, will soon be noticed, and promotion follow. If it comes only with age and your "turn," you will find yourself a better informed man and a better engineer. There is hope, there is a chance for earnest workers in this line. The next generation of locomotive engineers will be a better one than the present, as the present is better than the past. Strive to be near the masthead of the craft, not a mere mussel clinging to its bottom.

Book Notices

High-Steam Pressures in Locomotive Service. By Prof. William F. M. Goss, Dean of the College of Engineering, University of Illinois, Urbana. Published by the Carnegie Institution of Washington. 144 pages, 7 x 10 ins. Profusely illustrated. Price, $1.50.

This is an important addition to locomotive literature, from the fact that it presents in concrete form the results of an extensive series of tests that have been made to determine the performance of a typical locomotive when operating under a variety of conditions with reference to speed, power and steam-pressure. One hundred such tests under the able supervision of Prof. Goss are presented in the best possible manner. The description text is a model of lucidity, while the illustrations are of the best. The book should not only be in the hands of all interested in locomotive construction particularly, but it should be carefully studied by steam engine men generally. The engineering world is under many obligations to the learned Dean of the University of Illinois, and the work before us cannot fail to meet with much warm approval.

Automatic Block Signals and Signal Circuits. By Ralph Scott. McGraw Publishing Co., New York. 243 pages, 6 x 9 ins.; cloth, profusely illustrated. Price, $2.50.

The reputation of the McGraw Publishing Company is amply sustained in this excellent work, which is intended for the signal and railway engineer, the electrician, and the layman. Mr. Scott brings to his work a vast and varied experience and has the fine faculty of writing in a style that everybody can understand. He does not weary the reader with the history of signalling, but carefully selects from the varied types of construction employed in the signal equipment of railroad systems in actual operation and gives them the attention that their importance merits. Railway signalling has not yet reached a standard either in method or means, but Mr. Scott's book is valuable in pointing out the striking characteristics of the best features of the various systems in use at the present time.

Locomotive Breakdowns, Emergencies and Their Remedies. By Geo. L. Fowler. Revised and enlarged by Wm. W. Wood. N. W. Henley Publishing Co., 132 Nassau street, New York. 270 pages, 4½ x 6½ ins.; flexible cloth. Price, $1.

Mr. Fowler's excellent work has been for a number of years so well known among railroad men that little that is not already known could be said in praise of his paintaking descriptions of locomotive emergencies and how to remedy them. An important new feature in the present edition of the work is the chapter in reference to the Walschaert's valve gearing which is rapidly coming into popular favor in America. The air-brake chapter has also been expanded and the electric headlight fully described, so that readers who may have a copy of an earlier edition need not hesitate to procure a copy of the new edition, which is fully illustrated.

The commission appointed by the Dominion Government to inquire into and report upon the failure of the partly built bridge over the St. Lawrence River at Quebec, have finished their labors. The report says that faulty design was the cause of the disaster.

Tampa Northern Ten-Wheeler.

The Baldwin Locomotive Works have recently built three ten-wheel locomotives for the Tampa Northern Railroad. These engines are suitable for either freight or passenger service and the railroad company reports that their performance is most satisfactory. The tractive force of this design is 25,320 lbs. and the weight on the driving-wheels is 111,850 lbs., which gives a factor of adhesion of 4.4. The cylinders are 19 x 26 ins., single expansion, equipped with balanced slide valves, which are driven by the Stephenson link motion. The eccentric rods are straight and the links are placed ahead of the rocker shafts, to which they are connected by short transmission bars.

The driving-wheels are 63 ins. in diameter. The guides are of steel, of the two-bar type, and the crossheads are of cast steel with brass gibs. Side plates hold the gibs in place, and by removing the plates the gibs can be taken down without disconnecting the piston-rod or main rod from the cross-head body. The guide yoke is divided on the center line and strongly spliced, and each guide bearer is a separate piece securely bolted to the yoke. Thus in making repairs on only one side the other need not be disturbed and the leading driving tires can be removed without taking down the guides or yokes. The main rods are of I-section. having a strap stub at the back end with wedge adjustment for the brass, while the side rods are of rectangular section with solid end stubs.

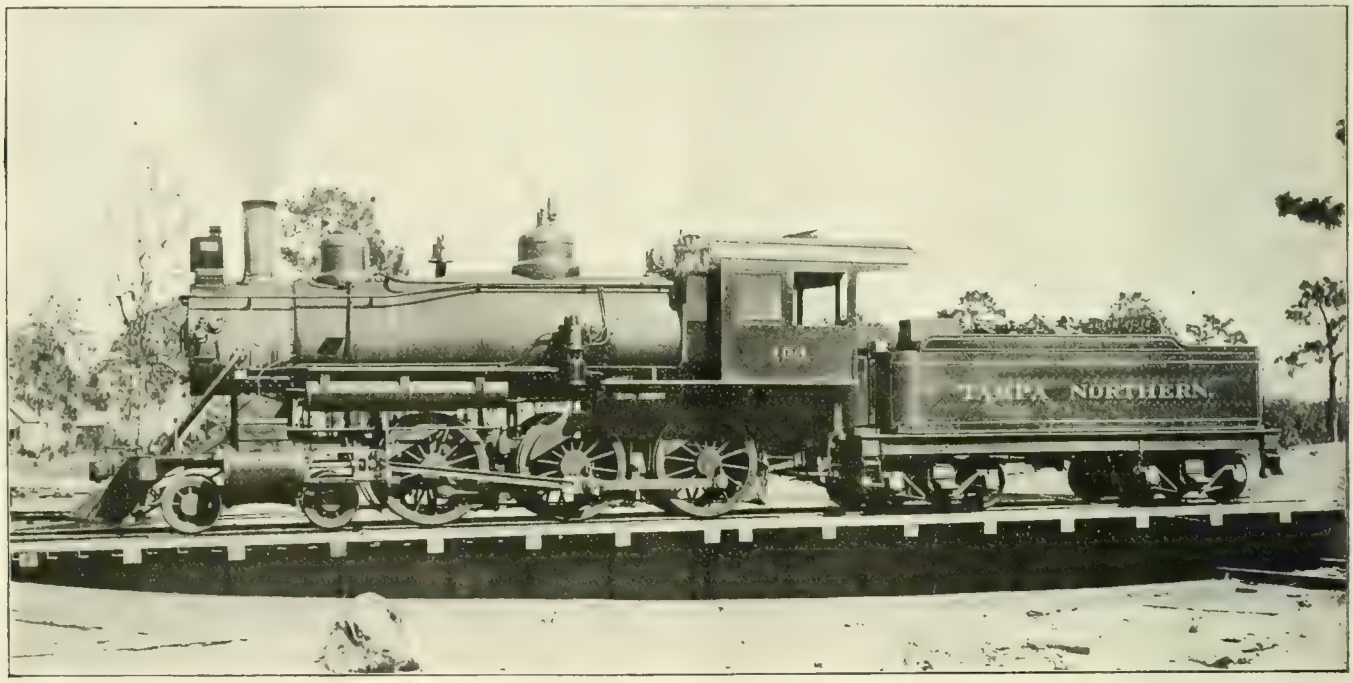
The cast steel details, in addition to those mentioned above, include driving-wheel centers, driving boxes, steam chests and foot plate. The frames are of cast steel with double front rails of wrought iron. The equalization system is arranged with beams over the second and third driving boxes and an inverted leaf spring between them. The engine truck is equipped with three point suspension links tending to the steady riding of the engine on curves. The truck wheels are steel tired with cast steel centers.

The boiler is of the extended wagon top type, with three rings in the barrel, the middle ring being tapered. The diameter of the boiler at the smoke box end is 62 ins. The longitudinal seams in the first and second rings are butt jointed with double covering strips, and the dome ring has a welded seam on the top center line with a reinforced liner inside. The firebox is radially stayed with one T-iron supporting the front end of the crown. The fuel is wood and the grate is composed of plain bars and dead plates. A straight mud ring is used and it is placed above the frames and supported on cast steel bearers. The smoke box has a short extension and the stack is of cast iron, 15½ ins. in diameter. Both injectors are in the cab, one being on the right side and the other on the back head. They feed through a double check placed on the top center line ahead of the gusset.

Mr. W. J. McGee, the master mechanic of the road, informs us that these new engines are so arranged as to make everything convenient in the cab for the engineer and he is able to operate the engine and reach the various appliances under his control without leaving his seat or taking his eye off the rail. The half-tone of engine No. 100, which we publish, has been made from a photograph supplied by Mr. McGee and it shows the engine as it appears on the turn-table ready for service.

The heating surface of this engine is in all 2,271 sq. ft. This is made up of 162 in the fire box and 2,109 in the flues. The tubes themselves number 281 and are each 14 ft. 5 ins. long. The grate area is 28.2 sq. ft. This gives a ratio of grate to heating surface as 1 is to 80.5. There is a fine netting used in the smokebox suitable for wood fuel. A change of netting and grate bars is all that would be required in order to convert the engines into coal burners.

The tender is carried on two arch bar trucks of 80,000 lbs. capacity. The frame is built of ten-inch steel channels and oak bumpers, while the tank is U-shaped with a flat top. The capacity of the tank is 5,000 gallons and four cords of wood are carried. The engine is intended for freight or passenger service as occasion may require. Some of the principal dimensions are as follows:



TAMPA NORTHERN RAILROAD TEN-WHEEL SIMPLE ENGINE.

W. J. McGee, Master Mechanic. Baldwin Loco. Works, Builders.

Fire Box.—Material, steel; length, 96 7/16 ins.; width, 42⅛ ins.; depth front, 73 ins.; depth back, 71 ins.; thickness of sheets, sides, 5/16 in.; back, 5/16 in.; crown, ⅜ in.; tube, ½ in.

Water Space.—Front, 4 ins.; sides, 3 ins.; back, 3 ins.

Tubes.—Material, steel; wire gauge, No. 11; diameter, 2 ins.

Driving Journals, 8½ x 10½ ins

Engine Truck Wheels.—Diameter, front, 30 ins.; journals, 5 x 10 ins.

Wheel Base.—Driving, 13 ft. 6 ins.; total engine, 24 ft. 4 ins.; total engine and tender, 53 ft. 10½ ins.

Weight.—On driving wheels, 111,850 lbs.; on truck, front, 37,550 lbs.; total engine, 149,400 lbs.; total engine and tender, about 250,000 lbs.

Tender.—Wheels, diameter, 33 ins.; journals, 5 x 9 ins.; tank capacity, 5,000 gals.; fuel capacity, 4 cords wood; service, passenger or freight.

Applied Science Department

Elements of Physical Science.

XII. Heat.

Heat is a mode of force arising from the action of molecules. It is not the only mode of force originating in molecular action. Electricity, magnetism and light are varieties of modes. Each of these forces are interchangeable into the others, and are frequently converted from one mode to another. The forces generated by heat are like matter in the quality of durability. Force is indestructible and no portion of it is ever lost. The various kinds of force are being constantly changed, but the quantity remains unaltered.

In our part of the universe the sun is the source of heat and light. The dynamic theory is generally accepted that the heat of the sun is transmitted by the rapid vibrations on its surface communicating with the ether and setting waves of motion through space. It reaches us, producing the sensations of light and heat. The ethereal disturbances striking on various bodies induces a vibration of their atoms and the sensation of heat is manifested. The perpetual and undiminished heat of the sun through countless ages is one of the inscrutable mysteries of creation, defying conjecture, as mighty as it is unfathomable.

COMBUSTION.

Combustion, or Burning, is perhaps the commonest process in which chemical action is exhibited. It is a chemical blending together of the oxygen in the atmosphere with a combustible body. The heat which accompanies the action ignites the gases or vapors and produces flame. A rapid supply of oxygen induces a rise in temperature. In the locomotive the use of the blower is an illustration of how a rapid current increases the temperature by inducing a more rapid chemical union of the oxygen with the material ignited.

Animal heat, on the other hand, remains nearly equable, but is produced in the same way as the hottest fires. In animal heat the combustion is slow. The air taken into the lungs of animals penetrate the blood vessels and unites chemically with the carbon from the tissues, and in this action heat is generated. The carbonic acid formed by the chemical action is discharged into the outer air, while a fresh supply of oxygen is keeping up the process. An increase in the supply causes an increase of heat, as is readily seen in running or other active exercise.

Heat is also induced by mechanical action, as in the rubbing of substances together, as in the friction of the bearing parts of machinery, and in this regard it is interesting to note the wide variations in metals and other substances in the conducting of heat. Metals are all rapid conductors of heat, while porous solids as well as liquids and gases are not good conductors of heat. Of the metals, silver is the best conductor. Professor Tyndal's tables in regard to the conducting power of metals are interesting as showing the marked variations in this attribute in metals. Placing the conducting power of silver at 100, that of several other metals is as follows:—Gold, 53; copper, 74; iron, 12; tin, 15, and lead, 9.

EFFECTS OF HEAT.

Heat has the quality of expanding bodies. Atoms in vibration act as if urging each other apart and consequently cause the body to which they belong to occupy a larger space. Solids that possess the quality of cohesion in a large degree expand the least. Fluids and gases having less cohesion expand more. Heat also changes solids into liquids, and liquids into gases, as in the case of ice, which heat changes into water and from water into steam.

It may be noted that bodies expanding by being heated do so with great force. This is particularly noticeable in iron bridges and other large structures. If provision was not made for this expansion a fracture of the parts would be inevitable. The expansion of liquids when heated is much greater than that of solids. Water heated to the boiling point increases in bulk nearly 5 per cent. Alcohol heated by the same temperature increases over 10 per cent., while gases and vapors increase over 30 per cent. at a similar degree of heat.

Water at various temperatures forms a striking exception to the general law that heat expands and cold contracts liquids. As water is cooled it contracts until it nearly reaches the freezing point. It then begins to expand. This wise provision of nature prevents ice from sinking in water.

STEAM.

Water when heated to 212° F. rapidly passes off in the form of vapor called steam. In an open vessel the water cannot be further heated, but in a closed vessel, like a locomotive boiler, the steam, being confined, presses on the water and prevents the ebullition or boiling. A much higher temperature can be obtained, the steam having the same temperature as the water from which it emanates. Steam is invisible. When cooled by the action of the cooler outer atmosphere, it begins to resume its original liquid state, first by assuming a gray mist appearance and then forming into drops of water. Steam has a high degree of expansibility, but retains this quality only as long as it retains the heat absorbed. As the heat passes away the condensation proceeds, and the steam is rapidly reduced in volume until it assumes its original form of water. It is this quality of expansion and contraction of the vapor rising from heated water from which the steam engine came into being, and which after long experiments became the perfected machine of to-day.

Facts About Rubber.

Nearly every person is familiar with the appearance and characteristics of so-called india rubber, or caoutchouc, to give its uncouth scientific name, but few people are aware that it is by chemists regarded as one of the most mysterious products of the vegetable kingdom. Chemists have carried on many expensive experiments to produce artificial rubber by synthesis, which is building up a substance on its known elements, but they have had very indifferent success with rubber, and their failures are said to be due to the general ignorance concerning the formation of rubber. They do not know whether it is actually present in the vegetable juices from which it is obtained, or is developed therefrom by chemical change due to the treatment to which the juices are subjected.

Some interesting facts concerning rubber were made public in an address delivered by Professor Dunstan at the last meeting of the British Association. He said that the product of the rubber tree had been greatly improved by culture. The juice of the tree is a watery fluid resembling milk, which contains the rubber or its immediate precursor, together with proteids and other minor constituents. The constituent furnishing rubber is in suspension, and rises like cream when the latex is at rest. On the addition of an acid, or sometimes of alkali, or even on mere exposure, coagulation takes place and the rubber separates as a solid, the other constituents for the most part remaining dissolved in the aqueous liquid or "serum." The first view taken of the nature of the coagulation process was

that, like the coagulation of milk by acids, it is dependent upon a process of proteid coagulation, the separated proteids carrying down the rubber during precipitation.

Although the finest caoutchouc for technical purposes is only yielded by half-a-dozen plants, under whose names these varieties of caoutchouc pass, there can scarcely be a doubt that the elastic substance in each case possesses a very similar, if not identical, chemical structure. Nearly all the latices and similar fluids furnished by plants contain more or less caoutchouc. Even opium, which is the dried juice of the capsule of the poppy, contains caoutchouc, while the opium yielded by certain Indian species contains a notable proportion. Chemistry must determine the means by which caoutchouc can best be separated from these relatively poor latices. In view of the increasing production of the nearly pure caoutchouc, the question is not a pressing one at the moment. Moreover, it can not be doubted that chemical science will sooner or later be able to take a definite step toward the production of rubber by artificial means.

Uses of Sawdust.

Many are the uses of sawdust. In the days when the sawdust wagon made its lumbering rounds through the streets of most large cities two commercial uses of sawdust were to sprinkle floors and to shelter lead pipes from cold and glass bottles from breakage.

Near every sawmill was a vat for the sawdust and it was carried away free by any one who had any use for it. In this era of the use of by-products sawdust has a commercial value. It is no longer given away, but is sold.

One of the recent uses of sawdust is its distillation, resulting in acetic acid, wood naphtha, wood alcohol and tar. Sawdust may also be burned in special furnaces or mixed with other material for fuel.

Sawdust, when saturated with chemicals, can be effectively used in the manufacture of explosives, but it is more particularly in demand in paper making than for any other purpose. Such a thing as sawdust on the floor of a room as a substitute for a rug or carpet is now practically unknown. Sawdust has joined sand in this respect.

Cotton felt has been substituted for sawdust as a non-conductor of cold in winter. Gas can be made from sawdust. It is also used for briquettes, i. e., blocks of compressed sawdust and wood chips burned for fuel. It has also been used in briquettes made of coal dust and tar, mixed together and formed under heavy hydraulic pressure and then dried. These have been made egg-shaped or in the form of blocks. Even in the protection of glassware against breakage sawdust has been superseded by excelsior, sawdust being regarded as too valuable for such use.

Can Go One Better.

"Near the end of the season our boy announced the height of our tall maple tree to be thirty-three feet.

"'Why, how do you know?' was the general question.

"'Measured it.'

"'How?'

"'Foot rule and yardstick.'

"'You didn't climb that tall tree?' his mother asked anxiously.

"'No'm; I found the length of the shadow and measured that.'

"'But the length of the shadow changes.'

"'Yes'm; but twice a day the shadows are just as long as the things themselves. I've been trying it all summer. I drove a stick into the ground, and when its shadow was just as long as the stick I knew that the shadow of the tree would be just as long as the tree, and that's thirty-three feet.'"

The above paragraph appeared in one of the daily papers which come to our office. The item was headed "A Clever Boy." Now we do not know who this advertised boy was, but we knew quite as clever a boy, one who could have got the approximate height of the tree without waiting for the sun to shine at a particular angle or to shine at all for that matter. The way Boy No. 2 went about the same problem was this: He got a stick and planted it in the ground and then cut it off just at the level of his eyes. Then he went out and took a look at the tree and made a rough estimate of the tree's height in his mind, and judging the same distance along the ground from the tree trunk, he planted his stick in the ground. Then he lay down on his back with his feet against the standing stick and looked at the top of the tree over the stick.

If he found the top of stick and tree did not agree he tried a new position and kept at it until he could just see the tree top over the end of the upright stick Then all he had to do was to measure along the ground to where his eye had been when lying down and that gave him the height of the tree.

The point about this method is that the boy and stick made a right angled triangle with boy for base, stick for perpendicular, both of the same length, and the "line of sight" the hypotenuse or long line of the triangle. When he got into the position which enabled him to just see the tree top over the top of the stick, he again had a right angled triangle with tree as perpendicular his eye's distance away from the trunk, the base, and the line of sight the hypotenuse. He could measure the base line along the ground and knew it must equal the vertical height, and he could do this without reference to the sun. It was an ingenious application of the well known properties of a right angled triangle.

Intensely Refractory Metals.

The production of the wonderful material carborundum is not the only amazing performance of the electric furnace. The intense heat generated has enabled chemists and metallurgists to melt the ores of extraordinarily refractory metals that have proved of the highest value in the mechanic arts.

The intense heat of the electric furnace has been successfully employed to separate from their ores metals that were formerly known to science merely as curiosities. One of these is tantalum, the hardest metal known, and so refractory that it can be used for filaments in incandescent electric lamps for many hours without oxydizing or burning out. Tungsten is another very refractory metal whose melting point is 5,500 degrees Fahr. This metal is coming into use as filaments for electric lights and greatly increases the briliancy and efficiency of the lights.

Questions Answered

LUBRICATION WITH SUPERHEATED STEAM.

25). W. L. M. E., Pueblo, Col., asks: What kind of lubrication is used with superheated steam? Is it forced feed or not, and please give outline of pipe connections? A.—One of the railroad companies which have gone into superheating very extensively have found every satisfaction in the use of the Detroit Sight Feed Lubricator for engines having superheaters. There are, however, separate deliveries to the valves and to the cylinders. Galena cylinder oil is used.

PUMP GOVERNOR OR BRAKE VALVE.

(26) L. C. P., of Covington, Ky., writes: "Will full pressure pumped up and both hands on gauge show the same pressure, is the trouble in the pump governor or brake valve?"—A. The duty of the pump governor is to control the speed of the pump, by throttling the steam supply, in such a manner as to maintain the air pressure in the main reservoir at the figure for which it is adjusted. The duties of the brake valve are (1) to control the flow of air from the main reservoir to the brake pipe; (2) to control the flow of air from the brake pipe to the atmosphere.

PRESSURE WITH FULL APPLICATION.

(27) L. C. B., of Covington, Ky., writes: "How much pressure do you get in a brake cylinder with a full service application?"—A. The piston travel should be adjusted so that the brake cylinder, and an auxiliary reservoir of the proper size, will equalize at a pressure of 50 lbs. per square inch when the original brake pipe and auxiliary reservoir pressure is 70 lbs.

PERCENTAGE OF CARBON IN STEEL.

(28) A. D. P., Moncton, N. B., writes: The other day I read about some car wheels made from what is known as an open hearth, high carbon steel, containing, as was stated, "point six-five to point seven-five carbon." These expressions are usually written .65 and .75; but the meaning is not clear. The steel cannot be nearly three-quarters carbon. What is the significance of the figures and what is the amount of carbon in the wheels?—A. Such a steel has in it .0065 to .0075 of carbon. Taking 100 parts as the total, the steel of which these wheels are made has as one constituent something between 65/10000 and 75/10000ths parts of carbon. This steel, though below tool steel in the amount of its carbon, is capable of being tempered, if such be required. This range of carbon percentage is often used for spring steel. The expression for the amount of carbon in steel is the fraction of one per cent. The expression point 75 carbon, when used to indicate the amount of this element in steel, means .75 of 1 per cent. and that is in the same proportion as 75 cents is to 100 dollars.

CAMEL BACK ENGINES.

(29) F. T. S., Loyalton, Cal., writes: I have heard the name "Camel Back" applied to engines. Are there any engines in use now that are properly termed camel backs? The term is applied now-a-days by some people to some kind of engine; what is that class?—A. In the "Development of the Locomotive Engine," by Angus Sinclair, there is a description of the class of engines called "Camels" and the whole history of them is given. The first was used in 1848 on the B. & O. There was an illustrated description of one of them on page 381 of RAILWAY AND LOCOMOTIVE ENGINEERING for September, 1902. If you look at the illustrations either in Mr. Sinclair's book or our paper you will see at a glance what a camel engine is like. Some people call the engines with centrally placed cabs camel backs, but this is not a good name; the term is purely local, and not generally used.

PRESSURE ON SLIDE VALVE.

(30) M. J. M., Missoula, Mont., writes: Suppose you have a steam chest valve face without ports faced up perfectly smooth and have fitted to this a piece of smooth iron 12 ins. square in area and 2 ins. thick. No steam gets between the flat piece and the smooth face and, there being no cavity in either, what will be the pressure on the back of this piece of iron of 12 ins. square, or 144 sq. ins., supposing it to be enclosed in a steam chest and 200 lbs. steam pressure turned on?—A. The fact that there is no cavity in either makes no difference; the pressure on the back of the solid piece of iron will be 28,800 lbs. under a boiler pressure of 200 lbs. to the sq. in. This is on the supposition that the two metal surfaces which are in contact are a perfect fit and no steam leaks in between them. Care must be taken not to confuse 12 sq. in., which would only have a pressure of 2400 lbs. on it, with the area of a piece 12 ins. square. In the case of an ordinary slide valve with the exhaust cavity full of exhaust steam at a low pressure, a certain amount of pressure on the back of the valve will be neutralized by the slight upward pressure of the exhaust steam, but the pressure on the back of the valve or the solid piece of metal you write of, will in every case be the product of the area in square inches exposed to pressure multiplied by the pressure per square inch. When you balance a slide valve you protect a certain area of the valve from the direct pressure of the steam.

DOUBLE BOILER CHECK.

(31) F. T. S., Loyalton, Cal., writes: Referring to the description of the Phillips Double Boiler Check valve on page 90 of your February issue, I would like to ask if the water is forced into the steam space of the boiler? I have always understood that water could not be forced against steam by the same pressure. Does not that theory still hold good?—A. No, this theory is not correct. With the Phillips boiler check the water is forced into the steam space of the boiler. The theory of the injector is briefly that steam from the boiler when flowing through the injector is a comparatively light body moving with considerable velocity and it encounters water, which is a comparatively heavy body. The steam although condensed yet imparts a certain velocity to the water and this comparatively heavy body of water now moving on a certain velocity is able to overcome the stationary pressure on the check valve whether that valve is submerged in water or simply surrounded by steam. The branch of science which treats of water in motion is called hydrodynamics, and a study of it will repay you. If the pressure of the water and the steam were exactly equal and neither had any motion, the water would not enter the boiler. The position of the check valve has nothing to do with the matter. The advantages claimed for this form of valve were set forth in our February issue.

RATIOS USED IN COMPOUNDING.

(32) W. R. H., Sacramento, Cal., writes: In studying the various rules for designing cross, or four-cylinder compounds as regards their relative cylinder volume ratios in both domestic and foreign practice, I find that the ratios between the high and low pressure cylinders range from 2.5 to 1, up to 3 to 1, but never greater. Authoritative text books upon the subject of compounding give the hard and set rule of 4 to 1. I can very easily see where large motive power is concerned that a 4 to 1 ratio would entail too large a low pressure cylinder, but in some of the Pacific type engines where comparatively small cylinders are used, the apparently authoritative ratios of 4 to 1 could be used. Would a student of engineering surmise by this that a ratio of 4 to 1 to be the most efficient and economical in a condensing marine engine where full load is encountered a greater part of the time, and a 3 to 1 ratio the best where varying throttle manipulations are required, as in a locomotive, the smaller low pressure volume of a 3 to 1 ratio preventing the expansion of low pressure steam to too low a pressure at least to the point found in the 4 to 1 ratio when throttling to half speed occurs or similar conditions?—A. The cylinder ratio for compound locomotives depends entirely upon the type and class of service. The late Mr. F. W. Webb, of the London and North-Western Railway of England, used ratios as low as 1⅞ to 1 for passenger service. The four-cylinder Vauclaim type had usually a ratio of nearly 3 to 1. For two-cylinder cross compounds a ratio of 2½ to 1 was generally employed by such builders as the Richmond Locomotive Works for freight service. This ratio gives good results where the loading is generally full, but there is considerable cylinder condensation in the low pressure cylinder whenever the engine was worked with less than full throttle. We are informed by a practical locomotive designer that he had better results in general freight service with a ratio of 2¼ to 1, and for passenger service where the engine is more often worked with partly closed throttle and notched up a little higher for speed, it appeared that a somewhat lower ratio still, or about 2⅛ to 1, was found to be more economical. Two-cylinder marine compounds have usually a ratio close to 3 to 1, but it should be remembered that a little loss by cylinder condensation during the working stroke may be more than offset by the condenser then having less to condense, and thus possibly producing a greater vacuum.

SUPERHEATED STEAM.

(33) W. L. M. E., Pueblo, Cal., writes: In locomotives equipped with the superheater why does not the pressure of the superheated steam back up through the dry pipe and raise the boiler pressure, causing equalization to be established between boiler and steam chest?—A. Superheated steam is steam heated to a temperature above that due to its pressure. It does not rise in pressure so as to back up through the dry pipe. Superheated steam contains more heat units than ordinary saturated steam at the same pressure, and superheated steam has to be deprived of this heat before it turns to water. It enters the cylinders capable of meeting

greater heat losses without so much condensation as ordinary dry steam. Superheated steam is simply dry, very hot steam but at practically the same pressure as the rest of the steam in the boiler.

EXPANSION OF RAILS.

(34) F. T. S., Loyalton, Cal., asks: What is the average expansion per foot of steel rails? For example, what does an 85-lb. rail expand, and is there contraction from extreme cold? —A. The expansion of a rail such as the one of which you write would probably vary about ¼ in. between summer heat and winter cold. This means that the rail would be longer in the hot summer days than it would be in the cold of winter by about that amount.

EFFICIENCY OF PUMPS.

(35) W. A. P., of Chico, Cal., writes: "How do you figure the efficiency of a Westinghouse cross compound pump, also a New York Duplex compression pump? I mean where the steam end of pump is simple and the air end is compound.—A. The efficiency of a machine is the ratio of its actual capacity to do work, as determined by experiment, to its theoretical capacity.

The displacement of the low pressure air piston in the Westinghouse 8½-ins. cross compound pump at each double stroke is 3,962 cu. ins., or very nearly 2.3 cu. ft. The displacement is found by multiplying the area of the low pressure piston by the length of its stroke.

The theoretical capacity of the 8½-ins. cross compound pump is, therefore, 3,962 cu. ins. per double stroke, and this is the quantity of free air which this piston should draw into the air cylinder, provided there were no losses. But as losses are sure to occur on account of cylinder clearance, packing ring leakage, weight of the air valves, and other similar causes, the amount of free air, or air at atmospheric pressure, drawn into the air cylinder at each double stroke never equals the theoretical quantity. Hence, to determine just how efficient the pump is, it must be tested, and the quantity of free air pumped per stroke be carefully measured.

Such tests of the cross compound pump have been made, and it has been found that when the pump is working at the rate of 55 double strokes per minute, against a main reservoir pressure of 130 lbs. for one minute, it will pump 108 cu. ft. of free air. If it could pump 2.3 cu. ft. at each cycle, its theoretical quantity, it would pump 55x2.3 = 126.5 cu. ft. Hence, the efficiency under the above conditions is found by dividing 108 by 126.5, and this gives 85.5 per cent. as the efficiency.

With the cross compound pump only the low pressure air cylinder need be considered, as this is the only one into which free air is drawn.

The efficiency of the No. 5 duplex pump is found in a similar way. It has two air cylinders into which free air is drawn at each stroke, and its displacement is per double stroke, or for one complete cycle, 3,912 cu. ins., equal to 2.25 cu. ft. Actual test of this pump under the same conditions named above for the cross compound pump shows that it will make 47 double strokes, or complete cycles in one minute, and it will pump 72 cu. ft. of free air.

Theoretically, for 47 complete cycles it should pump 47x2.25, equal to 106 cu. ft. Dividing 72 by 106 shows the efficiency of the No. 5 duplex pump to be 68 per cent.

As for the steam end of these pumps, the cross compound takes boiler steam only in the small, or high pressure steam cylinder, while the No. 5 duplex pump takes boiler steam in both of its steam cylinders.

The high pressure steam cylinder of the cross compound is 8½ ins. in diameter, and the stroke of the piston is 12 ins. Hence the amount of steam consumed at each complete cycle is practically 1,362 cu. ins.

As both steam cylinders of the No. 5 duplex pump are 8 ins. in diameter, and the pistons have a stroke of 12 ins., the quantity of boiler steam consumed at each complete cycle is 2,400 cu. ins.

In these calculations no allowance for the piston rods has been made.

Celebrated Engineers.

VI. Thomas Newcomen.

An important epoch was reached in the invention of the steam engine when Thomas Newcomen, a native of Devonshire, England, turned his attention to the water pumping machines of Worcester & Savery. He was an ironmonger in Dartmouth and one of Captain Savery's pumping engines was at work in a mine in the vicinity. In 1705 Newcomen obtained a patent for an important improvement on what he called a fire engine, but which was in fact an atmospheric steam engine. His invention may properly be said to be the first practical success in the operation of a piston engine. Newcomen's first important step was in the separation of the cylinder from the boiler. The admission of steam from the boiler was sufficiently strong to raise the piston in the cylinder, the piston nearly counterpoised by weights attached to a beam. When the piston had arrived at the upper end of the vertically placed cylinder the steam was shut off and a jet of cold water was admitted into the cylinder, condensing the steam. Consequently the piston was forced down by the pressure of the atmosphere acting on the upper surface of the piston.

The next entry of steam expelled the water from the cylinder through an escape valve. A layer of water on the upper surface of the piston helped to keep the piston air tight. The steam pressure used was little more than the atmosphere and the force of the engine was entirely the result of the vacuum caused by the condensation of the expanded steam. It was purely an atmospheric engine, and the opening and shutting of the valves was an operation which at first required great care and attention. Under the best conditions the apparatus of Newcomen absorbed in friction and by the imperfection of the condensing process nearly half of the entire power of the engine, not more than eight pounds being raised by each superficial inch of the piston.

For many years the most important movement of the machine depended not only for its production but for its precision upon the care and attention of the person who attended the engine. The most unremitting care fell short of that demanded for the perfect development of the full power of the engine. After opening the steam cock the upward movement of the piston had to be observed and at the exact instant the steam had to be shut off and at the same moment the jet of cold water had to be admitted. If the one was not immediately followed by the other there resulted a great loss of vapor. When the condensation had occurred and the piston had begun its descent, if the communication between the boiler and cylinder was not opened at the proper instant, the weight of the piston falling with considerable velocity would shake the apparatus to pieces. The number of strokes per minute was the test of the attendant's skill, and a clever manipulator reached as high as fourteen strokes per minute.

Several important improvements were gradually perfected. A boy named Humphrey Potter, whose duty it was to open and shut the valves of an engine he attended made the engine self-acting by causing the beam itself to open and close the valves by suitable cords and catches. This was in 1713 and five years later Henry Beighton suspended from the beam a rod which worked the valves by means of tappets. Newcomen's atmospheric engine did good service for seventy-five years, especially in pumping water from mines.

The bridge at Lethbridge on the Crow's Nest line of the Canadian Pacific Railway in British Columbia will, when completed, be one of the longest if not the longest bridge in the world. It will be about 300 feet high. Tenders for the construction of this bridge have been called for.

Air Brake Department

Brake Valve Cleaning and Repairs.

Taking a brake valve apart, cleaning and lubricating it is a very simple operation, but this is not always all that the brake valve requires.

An inspection of the brake valves on engines in some round-houses will convince an air brakeman that the work of cleaning and repairing brake valves is often sadly neglected or done by careless or incompetent workmen. Sometimes they are "cleaned and oiled" without taking the valve apart, sometimes the rotary valve and seat are cleaned without paying any attention to the rotary key gasket or the equalizing piston, the equalizing piston especially where the reversing cock and feed valve bracket is used, which means breaking the pipe joints before the piston can be removed.

Sometimes a piece of tin is used to bush the key-way in the valve handle, when it is worn, until there is considerable lost motion in the handle and key. Frequently valves are allowed to run in this way until enough lost motion develops to prevent the valve from being lapped until brought back on the notch between lap and running position. When a valve of this kind is brought to running position there will be but about one-half of the maximum port opening.

If no new parts are obtainable to repair the valve when in this condition, mashing the handle on the key in a vise is a much better practice than bushing with tin, and when a workman becomes careless about matters of this kind he becomes dangerous. There is one important part of the brake valve that should never be overlooked, namely, the engagement of the rotary key in the rotary valve.

The manufacture of the G6 brake valve will soon cease and there will be any number of old valves to be worn out to save the expense of "scrapping" all of them at one time, and great care should be taken to see that the valve and seat are not worn enough to allow the rotary key to become disengaged from the valve when in service.

When the valve and seat are new and a standard 5/32-in. rotary key gasket is used there is about 1/32 of an inch clearance between the gasket and valve body; the key has then very nearly ⅜ of an inch engagement in the valve and when ⅛ of an inch is removed from the combined wearing surface of the valve and seat it cannot be ground any more and the worn part should be renewed, for when the rotary key gasket is then about worn out there will be but about ⅛ of an inch engagement in the valve, or the distance from the upper outside edge of the rotary valve to the base of the seat on which the upper body gasket rests is 2 ins. when the valve is new and when it is reduced from wear and grinding to less than 1⅞ ins. it is not considered safe to use.

Here is where the repairman sometimes economizes by using two rotary key gaskets to fill up the space between the key and the valve body, which is a dangerous practice, as the keys have been known to slip out of the valve when the engine was handling a train of cars.

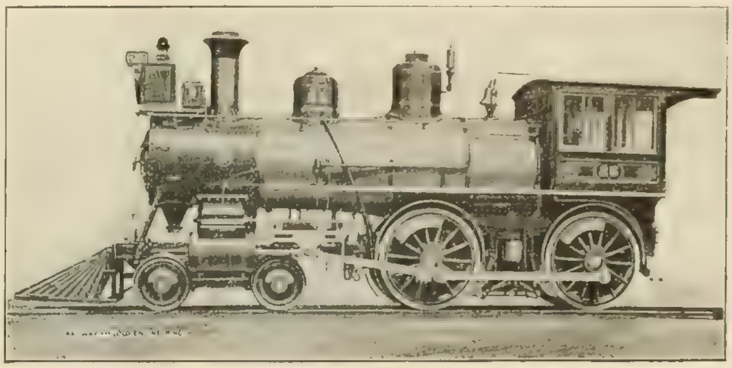
If the rotary valve, upper body gasket, the valve body and the rotary key with the rotary key gasket removed are placed in their positions the rotary key can be marked at the point where it projects from the valve body and then drawn up as far as it will come and marked again. The distance between the marks subtracted from ⅜ of an inch will represent the engagement of the rotary key when the gasket is entirely worn out, which should not be less than ⅛ of an inch.

While the equalizing piston and packing ring are very important, they are not actually dangerous during train brake applications, for if the piston does fail to respond the direct application is not affected. The ring should be a neat fit and have a good bearing all the way round.

A good way to fit a ring is to only file the open end enough to come together tight at the ends and spring the ends inward by holding a small piece of steel, similar to a knife blade, between the piston and ring and pressing in on the end of the ring. With a little practice the ring can be sprung to a pretty fair bearing, which will avoid much filing, scraping and grinding on the outer edge of the ring, which steadily increases the opening at the ends.

While it is not desirable to have the piston ring an air-tight fit, because the black hand of the gauge should show brake pressure when the handle is on lap. and in a two application stop, when the handle is brought to lap position after the first application, the equalizing reservoir pressure should equalize with the brake pipe as well as the brake pipe with the auxiliary reservoirs in order to secure a prompt response from triple valves on the second application, yet the ring should be a close enough fit that the equalizing piston can be lifted about four times with a five pound application from the brake pipe of the lone engine. Occasionally when handling a long train of cars a 10-lb. reduction may be made and by the time the brake pipe exhaust closes the gauge will show that the reduction has been but 8½ or 9 lbs., which indicates leakage from the brake pipe into the equalizing reservoir, which can be determined with the lone engine by plugging the brake pipe exhaust, and with full brake pipe pressure placing the handle in service position. After the equalizing reservoir pressure is exhausted and the black hand has reached the pin the leakage from the preliminary exhaust port represents that which is passing the piston packing ring and lower body gasket into the equalizing reservoir.

The undesired emergency so often discussed is frequently the fault of the brake valve. Sometimes it is the result of slight disorders of both the brake valve and triple valve, neither in itself sufficient to cause any unusual action, but when com-



TYPICAL 4-4-0 LIGHT PASSENGER ENGINE.

bined occasionally cause the emergency application with the valve handle in service position. When it occurs every time the service is attempted, the trouble can easily be found and remedied, but when it only occurs occasionally it is more difficult and somewhat dangerous, as the fireman is liable to be thrown from the tender when backing into the train shed or taking water.

The triple valve and the brake valve each have about three common causes for the emergency, with a service application, any of which will only cause it under certain conditions.

The triple valve with the broken graduating pin may go into the emergency with a long or a short train, yet if in the rear of a long train the reduction may be gradual enough to move the piston slowly against the graduating stem and partially compress the spring and reduce the auxiliary reservoir pressure past the loosely fitted emergency piston into the brake cylinder.

The sticky triple valve in the rear of a long train may never be moved if the reduction in the brake pipe is not very rapid and the auxiliary pressure will leak back into the brake pipe through the feed groove.

The effect of the brake valve disorders can be found on the lone engine. The sticky equalizing piston is likely to throw the quick action triple valve on the tender into the emergency. The piston need not be dirty to do this. If the ring is turned too large and bears too hard against the bushing it is a sticky equalizing piston.

The opening through the preliminary exhaust port bushing should be 5/64 of an inch, and when a 5/64 piece of steel wire can be worked around in the bushing freely the exhaust port is enlarged and should be rebushed, especially if the high-speed brake is used.

Insufficient equalizing reservoir volume is an occasional cause of the undesired emergency.

The effect of equalizing reservoir leakage depends upon the amount of leakage and the condition of the equalizing piston packing ring. If the packing ring leakage is equal to the leakage from the equalizing reservoir to the atmosphere the piston will not be lifted with the valve handle on the lap position, but the leakage may decrease as the piston is lifted in service position, and the equalizing reservoir leak may assist in causing the undesired emergency.

The leakage from the equalizing reservoir may occur from the reservoir itself, in the pipe connections to it, inside of the air gauge, from the lower body gasket of the brake valve, from the stud on which the holding nut is screwed or on the seat of the rotary valve itself.

When the report, "clean brake valve," is entered on the engineer or inspector's report of the condition of the engine, it is taken to mean the rotary valve and equalizing piston, the feed valve attachment not being considered unless it is specially referred to in the report; in fact it is seldom given any attention at all if the gauge shows the proper brake pipe pressure. If the brake pipe pressure is of any consequence when it comes to stopping a train the valve which controls it must also be of some consequence.

Some feed valves may be said to maintain the brake pipe pressure, others may be said to restrict it to a certain figure. When the feed valve very slowly increases the brake pipe pressure above the figure for which it is adjusted it at once becomes the subject of a report and a discussion, while nothing whatever may be said about one in a much worse condition so long as the air gauge shows 70 or 110 lbs.

The feed valve should be cleaned regularly, and it should be tested on a rack where conditions are always the same. While the spring box is removed and the supply and regulating valves are being tested for leakage, the supply valve and piston should be moved when the regulating valve is unseated by pushing the finger against it. The decrease in the length of time the supply valve is unseated shows the increase of leakage past the supply valve piston.

When the piston becomes so loose in the bushing that air passes it as fast as it can escape from the seat of the regulating valve, the supply valve cannot be unseated by the diaphragm's spring pressure, and the brake pipe cannot be supplied any faster than the flow past the regulating valve seat, which will supply the short brake pipe on the engine, but not the leakage on the average train.

The flush nut should be removed in order to clean the feed valve properly, and it should be known at this time that the piston and slide valve will travel far enough to entirely uncover the port through which the brake pipe is supplied, as there are several different styles of feed valves and the parts sometimes become mixed.

Before the feed valve is attached to the brake valve the pressure should be pumped up with the valve handle on lap. Leakage through the brake valve will then show at ports f, i, or k. Leakage from port i sometimes comes from the brake valve cut-out-cock if it is located in the reservoir pipe.

If a reversing cock is used, the leaks will show at the corresponding ports in the cock, and the handle should be moved to running and release positions to see that the pipe connections and ports through the cock are not partially closed. Leakage through the reversing cock will show if its handle is placed half way between the two positions when the brake valve handle is moved to running and release positions.

When adjusting the feed valve in some cases the last two or three pounds will accumulate very slowly and after the feed valve is known to be in good condition, otherwise it can be adjusted with the bleeder cocks open on the engine and tender auxiliary reservoirs, which will represent the average train leakage, although with the larger triple valves it may represent a little more and the cock can be partially closed.

Stopping Heavy Freight Trains.

In a highly practical paper presented to the Central Railroad Club by Mr. John A. Talty, the able traveling engineer of the Lackawanna Railroad, the following sensible directions were given to engineers handling heavy freight trains:

The importance of operating the air brakes both in passenger and freight service, should not be underestimated by the enginemen.

When expecting to make a stop, the throttle valve should be closed a sufficient length of time to give slack time to bunch before application of the air brake is made.

On roads handling freight trains from 50 to 100 cars in length, the initial reduction should not be less than 12 or 15 pounds and a further reduction should be made after the speed is reduced to 8 or 10 miles an hour, so as to fully apply brake on engine before the train has been brought to a stop.

There has been more or less detention on the road when handling mixed trains as compared with solid trains, caused by the unequal braking power of the loads and empties. When the rear portion of a train consists of empty cars, in many instances, after brake has been applied, the braking power on the empty cars is sufficient to part a train just before the train is brought to rest. Instructions that would decrease the liability of trains parting in such a manner are as follows:

"For instance, when handling 25 loaded cars on head end and 50 empty cars on rear end, the initial reduction should not be less than 15 lbs. and after the speed of train has been reduced to about 4 or 6 miles per hour, a further reduction should be made to fully apply the brakes on engine and forward portion of train, and if train can be brought to a stop with air still flowing through the train line exhaust, a less strain is put on the equipment, due to braking power being decreased on rear cars."

An agitation was started by some New York newspapers about twenty years ago to introduce the teaching of locomotive engine running into the public schools. Some of the education leaders endorsed the scheme, but they wished to have real locomotives to experiment with. This plan of industrial education died a natural death.

Electrical Department

Subway Electric Control.

By W. B. Kouwenhoven.

In the December, 1907, issue of Railway and Locomotive Engineering the manually operated type of controller was described. This controller is known as the type M control, and is manufactured by the General Electric Company in both the manually operated and automatically operated forms. The automatically operated controller is used in the New York Subway.

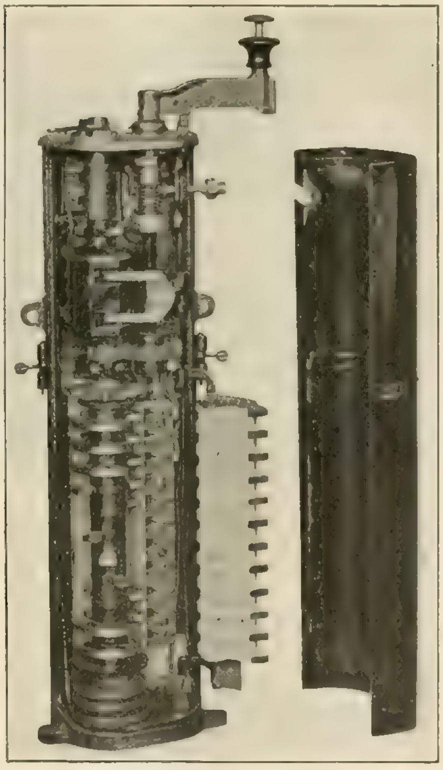
The automatic system of control differs but slightly from the manual system. In the automatic the train line consists of ten wires; in the manual there are only nine. The motor control of the automatic comprises sixteen contactors, a reverser and eight rheostarts or resistance coils. On the manual control there are but thirteen contactors, a reverser and six rheostarts. Both types have the same number and arrangement of circuit breakers, fuses and third rail shoes. In addition to these differences the automatic type is equipped with a relay in the motor circuit, a control governor placed in the controller box, and the master controller handle is not connected directly to the controller drum, the connection being made by a coiled spring.

On the upper end of the controller drum or control cylinder, as it is sometimes called, is situated the control governor. This control governor is in reality a magnetic clutch—that is, it is a clutch whose operation is brought about by means of electro-magnets. The clutch consists of several shoes which are arranged so as to press against a small wheel or shell mounted on the upper end of the controller drum. When these shoes press against the drum they hold it stationary and prevent its further rotation. Ordinarily these shoes do not press against the shell, but when the electro-magnet which controls their operation is energized they clamp the drum in position. The electro-magnet that operates these shoes is called the lock coil of the control governor. The lock coil is energized by the relay, whose action will be explained later.

On the manual type of control the motorman advances his controller handle as rapidly as he considers proper and the rate of application of power depends entirely upon him. No two motormen apply the current at the same rate, and seldom does a motorman apply the power at exactly the same rate each time. In the automatic control the rate of application of power is not directly under the control of the man. The automatic type produces an even rate of current application, and thus in a sense eliminates the personal equation. This even rate of current application secures a uniform rate of acceleration in the train.

On starting a car equipped with the manual type of control the motorman advances his controller handle step by step, and regulates the time allowed for each step in the application of power, as was described in our December issue.

When the automatic type is employed the motorman throws his controller handle to the full speed multiple position with



ONE OF THE G. E. TYPES OF AUTOMATIC CONTROLLER.

one motion when he starts the train. This motion winds up the coiled spring which connects the master controller handle to the controller drum or control cylinder, as it is sometimes called. The reaction of this coiled spring advances the drum to the first point, where a set of segments make contact with a set of fingers. When the control cylinder has been advanced to the first notch, it energizes the contactors, which feed the heavy currents to the motors. This motor current, besides passing through the contactors, the reverser, the rheostarts and the motors, passes through the relay that operates the control governor. The control governor regulates the rate of advancement of the drum and thus controls the rate of acceleration. The rate of application of power depends upon the rapidity with which the drum advances from notch to notch. This relay is attached to the reverser, and consists of a few turns of heavy wire, forming a solenoid through which the heavy motor current passes. The relay is provided with an armature that is attracted by the solenoid.

As was stated in the article in our December issue, it is not desirable to lead the heavy currents into the controller box, so this relay is employed to handle the heavy currents and to furnish a small current to the lock coil of the governor. The armature of this relay, when attracted against the pressure of a light spring, closes two contacts through which is fed a small current from the controller governor. The energization of the lock-coil holds the control cylinder stationary. This prevents the rotation of the drum on to the next notch as long as the armature of the relay is held closed. The coiled spring tends to drive it ahead but the brake shoes of the governor hold it fast.

As the speed of the car increases the motors themselves automatically cut down the current, and when the current falls below a predetermined limit for which the relay is set, the spring pulls back the armature of the relay thus deënergizing the lock-coil of the governor. This relieves the pressure of the brake shoes on the shell and the coiled spring revolves the controller drum to the second notch, thereby cutting out some of the resistance in series with the motors.

This cutting out of resistance causes an increase in current and the relay again attracts its armature and again energizing the lock-coil of the governor and preventing the further rotation of the drum. When the speed has increased sufficiently to once more cut down the current, the armature of the relay drops and allows the coiled spring to advance the control cylinder another notch. This is repeated until the current is full on and both motors are in the full speed or multiple running position. It is impossible for the controller drum to get in advance of the controller handle because the coiled spring would not possess the energy necessary to advance the drum unless the controller handle was ahead of the position of the drum.

This automatic type M control and the Westinghouse multiple unit control are

alike in principle; they differ, however, in the form of the devices used. The Westinghouse multiple unit control was described in our January issue.

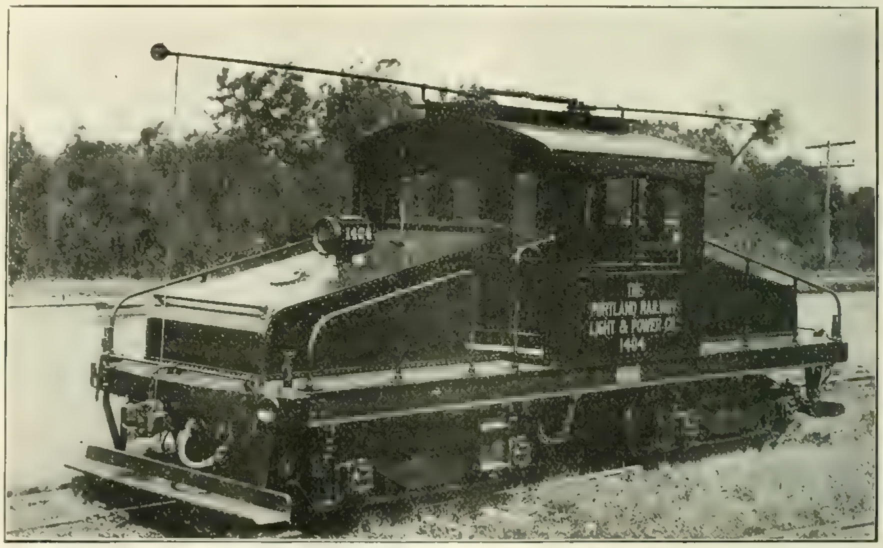
The unit switches of the one replace the contactors of the other. The coiled spring in the controller box of the type M of the General Electric corresponds to the interlocks that are attached to the unit switches of the multiple unit control. Both tend to notch up the control and to feed the current to the motors in successive steps. The relay with its lock-coil that regulates the action of the control governor corresponds to the limit switch with its two contacts which govern the closing of successive unit switches. Both of these devices govern the rate of application of power to the motors, thereby producing a uniform rate of acceleration, and both depend for their successful operation upon the current fed to the motors.

Electric Locomotive for Portland.

Among recent electric locomotives the one here illustrated possesses some features of unusual interest. It is one of two 40-ton switching locomotives built for the Portland Railway, Light & Power Company of Portland, Ore., by the General Electric Company and the American Locomotive Company at their Schenectady works.

The motor equipment consists of the latest types of what is called commutating pole motors as developed by the General Electric Company. For locomotive service this type possesses advantageous features in its freedom from commutator troubles under excessive conditions of overload. It must be borne in mind that in railway service the maximum torque demanded of a locomotive under starting conditions, particularly on grades, is often four or five times that demanded under ordinary full speed running conditions, and in addition to this, a locomotive in switching service is often operated with power applied to the motors for a very small proportion of the total time. The amount of time lost in drifting, or as electricians call it, coasting, making switches without power, waiting for couplings and other delays, in some recent tests amounted to well over 75 per cent. of the time that the locomotive was engaged in a service that could fairly be called continuous. As an illustration of what these motors can do, it may be stated that the motors at their one hour rating exert a tractive effort of 9,200 lbs. at a speed of 16½ miles per hour. Under starting conditions the same equipment is easily capable of slipping the wheels under a 40-ton locomotive and exerting a tractive effort of 20,000 to 25,000 lbs. without danger from commutator troubles.

The electric equipment of the locomotive aside from the motors consists of type M multiple unit control, with contractors and rheostats in what the builders call the auxiliary cabs, which look like sloping tank tops. The controllers are placed at the engineer's operating position in diagonally opposite corners of the main cab. It will be seen from the illustration that the locomotive is equipped with two trolleys, in order to avoid the necessity of turning the trolley in switching service, and to provide an additional carrying capacity when engaged in service so heavy as to call for the full overload capacity of the locomotive. There is in the center of the main cab an air compressor, having a capacity of 50 cubic ft. displacement when delivering air at 90 lbs. pressure.



ELECTRIC LOCOMOTIVE FOR THE P. RY. L. & P. CO.

Referring to the mechanical construction of the locomotive, the cab is of the type which has been standardized by the manufacturers for switching service, having, as may be seen from our half-tone, a main central operating cab, and sloping ends, containing the auxiliary apparatus. The ends are each a separate framework of angles and sheet iron bolted to the platform and main cab so that they may be removed without disturbing any of the apparatus contained therein. The main cab is furnished with ample windows, giving practically unobstructed views in every direction. Side platforms run from the entrance of the main cab to the ends of the locomotive, giving easy access to switching steps and couplers. The locomotive platform is built of four 10-inch longitudinal channel irons securely fastened to the end frames or bumpers which are of cast iron cored out to obtain only the necessary weight, with push pole sockets cast at the ends. The main cab is built of structural steel angles and sheets, with a platform of ⅜-in. sheet steel covered with ¾-in. hardwood.

The two ends of the locomotive are equipped with standard M. C. B. vertical plane couplers, having shank springs and follower plates, carried in a draw head casting attached to the main sills of the locomotive. The truck is of the bar frame rigid bolster type. It is an equalized truck, the equalizer bars being wrought iron and extending from box to box. The bolster is bolted rigidly to the side frames and the weight of side frames and bolster is transmitted to the equalizers through a heavy semi-elliptic spring on each side.

The bolster casting extending along the side frames plays an important part in squaring the truck. The bolsters and frames are further stiffened by two arched cross ties located equally distant from the center of the truck. The bolster is rigidly bolted to these cross ties at the center, and they in turn are rigidly bolted at the ends to the bottom tie bars of the frame. The center plates, lugs for brake hangers and levers are integral with the bolster casting, thereby giving a design of truck with a minimum number of parts and great rigidity. The driving axles are 6 in. in diameter and are made of hammered open hearth steel, with 33 in. Taylor fused steel tired wheels having M. C. B. tread and flange.

The locomotive is equipped with bell, whistle and headlights. The headlights are 32 c. p. incandescent, and 4 candle power gauge lamps are wired in each headlight circuit and controlled by the same switches.

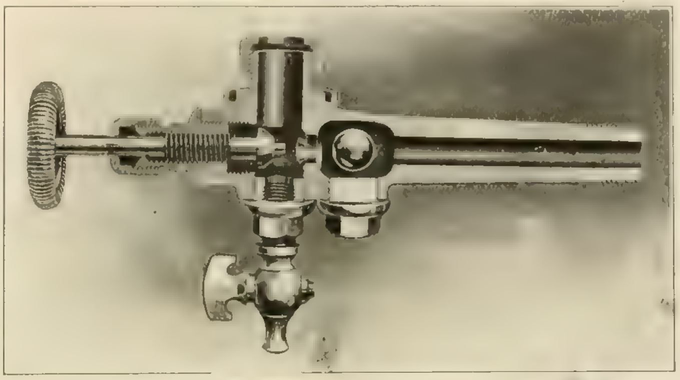
The principal dimensions of the locomotive are as follows:

Length inside to inside knuckles, 31 ft. 1 in.
Height over cab, 11 ft. 9 ins.
Length rigid wheel base, 6 ft. 6 ins
Width over all, 9 ft. 6 ins.
Weight on drivers, 81,000 lbs.

Patent Office Department

WATER-GAUGE.

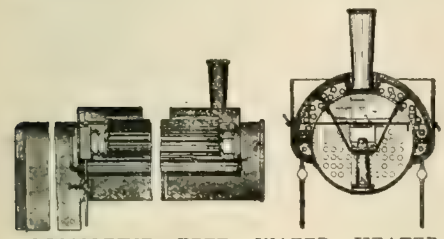
Mr. C. D. Shaff, M. M., N. Y. C. lines at Watertown, N. Y., has invented and patented an improved water-gauge, which is already meeting with much favor. Since the adoption of the new law in relation to locomotive boilers in New York State glass gauges are again coming into favor, and Mr. Shaff's new device combines a gauge glass mounted between two casings in the usual way. The glass may be removed or inserted without removing the gland nust, but the chief improvement consists in the check valves, which, as shown in the accompanying illustration, consists of plain metallic balls disposed in the inner chambers of the casings in such a manner that they are directly in the path of the pressure from the boiler and in the case of the glass tubes breaking they shut automatically, as the balls are larger than the parts leading to the boiler or to the gauge glass. A small by-pass valve is provided, which permits the pressure to become equalized when a new glass is installed. A wire gauze completes the device which in point of safety and simplicity is a marked improvement in water-gauges.



LOWER WATER GAUGE MOUNTING.

FEED WATER HEATER.

Mr. S. A. Morgan, Indianapolis, Ind., has patented means for heating feed water for locomotive boilers. The chief features of the device are means to divide the draft in its passage from the smoke arch of the locomotive and to cause the draft to pass through smoke chambers at the sides of the boiler and to return to the smoke-stack, meanwhile having given up heat sufficiently to heat the feed water in the pipes situated within the chambers. Means are also provided for collecting cinders at the bottom of the chambers and emptying the same. Mud drums are also attached to the apparatus which can be blown out at intervals.



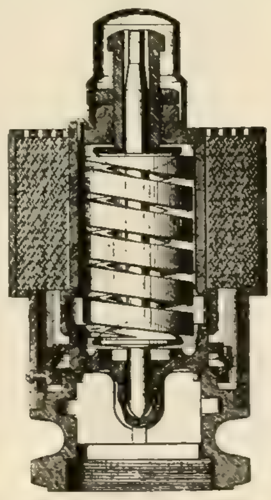
LOCOMOTIVE FEED WATER HEATER.

HEADLIGHT BLIND.

A locomotive headlight blind for increasing or diminishing the diameter of the headlight has been patented by Mr. F. J. Ewings, Duluth, Minn, No. 879,377. The device embraces a fluid pressure operated, means for expanding and projecting the blind and for retracting the same. There is also means forming a part of the blind for indicating the number of a train.

MUFFLER.

Mr. E. B. Crocker, Bridgeport, Conn., has patented a muffler for safety valves, No. 871,775. The device embraces a safety valve with a surrounding mufffler, a shell provided with an inlet and an outlet and a muffling element, inclosed and filling the shell, and consisting of a helically coiled apertured metal sheet formed with shelves standing out at an angle from the sheet, the axis of the coil being substantially parallel to the course of gases passing from the inlet to the outlet. The shelves are also inclined to the axis of the coil.



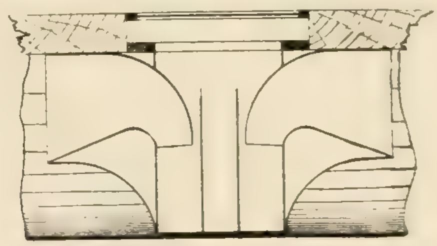
SAFETY VALVE MUFFLER.

SLIDING DOORS.

Mr. C. M. Donaldson, Chardon, Ohio, for many years road inspector for the B. & O. railroad, has patented an important improvement in sliding doors. By an ingenious arrangement of hanging devices the door is easily operated, and, combining strength and durability, it is impossible for the door to buckle, bind or drag and cannot leave the track when once placed in position. The exterior frame is made of angle metal, and is divided into panels by vertical and horizontal bars. The panels are filled by plates. Attached to the car are a series of hangers carrying anti-friction rollers upon which the door is suspended by supports, which present minimum friction surfaces and enable the door to be readily moved in either direction. Competent critics claim that it is the only non-destructible, easily operating door on the market. It has been tried on several western roads with very satisfactory results, and bids fair to become popular.

CAR VENTILATOR.

Mr. T. H. Garland, general agent refrigerator service, C., B. & Q. Ry., has recently perfected and patented a system of car ventilation which is rapidly coming into popular service. As shown in the accompanying illustration, the ventilator is constructed upon the aspirator principle, and draws out the impure air from a car to which it is attached, and it is impossible that smoke, cinders, rain or snow can enter the car through the ventilators. There are two air intakes and three exit vents, the latter opening through the roof or deck of the car. The swift passage of air through the exhaust tubes produces a suction that draws out the air from the top of the car. Repeated experiments have shown the utility of the system, not only for refrigerator cars, but for general passenger cars.



VENTILATOR FOR CARS.

Tunnel Indicator.

Perhaps the most complete, and one might also say artistic, piece of apparatus in use on any railway is the indicator for showing the position of trains in either of the twin tubes which form the tunnel under the East River at New York. This unique piece of mechanism is in the dispatcher's office at the Bowling Green station of the Interborough Rapid Transit Subway.

The tubes under the East River connect New York and Brooklyn and are each a little over a mile and a half long. In each tube there are seven blocks, protected by home and distant signals with the automatic stop apparatus, and the indicator in the dispatcher's office gives visible announcement of the position of any train which enters the tubes as it makes its way under the waters separating the two cities.

The indicator is a box about 2 ft. 6 ins. long by 12 ins. high and 9 ins. thick. This box is supported on a suitable stand and has a muffed glass front, on which is drawn a miniature representation of the tubes, which consists of two illuminated bands each half an inch wide, which dip and rise in accordance with the grades of the tunnel, and along which are marked, at accurately scaled distances, the signals, the telephone stations and the ventilating shafts. The upper band of light represents the south tube, through which the traffic ex New York passes, and the lower one represents the north tube, through which pass the trains coming from the Borough Hall in Brooklyn.

The indicator, with its miniature reproduction of the actual tunnel, is lit by a series of small incandescent electric lights behind the muffed or frosted glass of the case. Each section on the indicator corresponds to a signal block and is cut off from the next, so that the illumination of each, though separate and complete in itself, yet forms a continuous ribbon of light across the face of the indicator for each tube when all the bulbs are lit.

This is not all. The beauty and utility of the device become apparent as soon as the passage of a train through one of the tubes takes place. In each of the tiny sections of the indicator, corresponding to an actual signal system block, there are two small electric bulbs. One of these bulbs is encased in red glass and the other is encased in green glass. Suitable electric connection is made with the track circuit which operates the signals, so that when the tunnel is empty of trains and all the large signal lights in the tubes show green, for clear, the indicator shows the clear tubes as a pair of ribbons of pure green light.

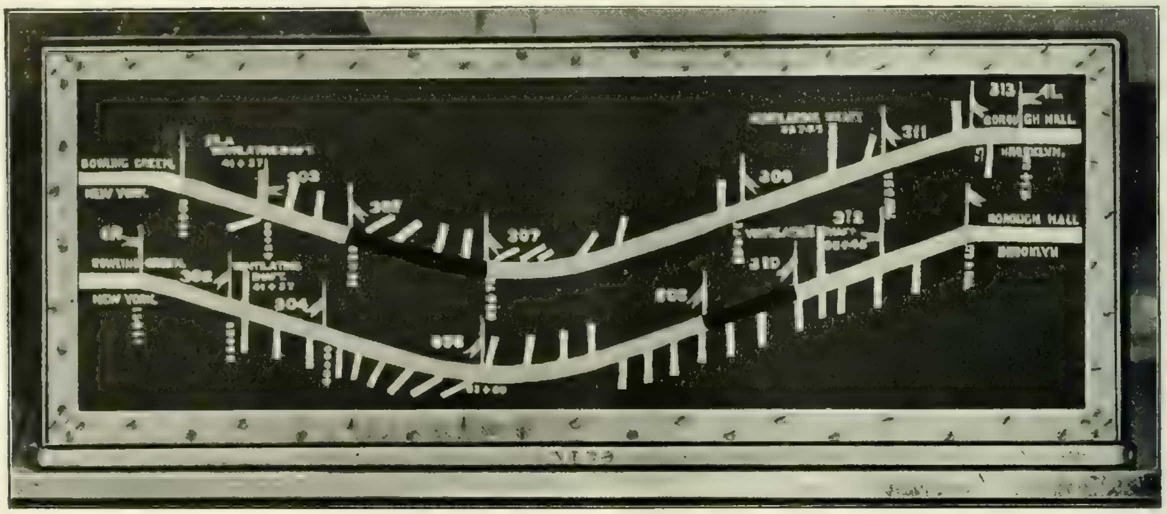
When, for example, a train enters the north tube, as it does shortly after leaving Borough Hall station in Brooklyn, the home signal behind it turns to red and at the same time the green light in the first miniature section of the indicator dies out and the red bulb glows, showing that a train is in the first block. As the train proceeds and enters the second block the color of the second miniature section of the indicator turns red and as the tail of the train leaves the first block in the tunnel the representative space on the indicator glows again with green light.

In this way the progress of the train is shown like a glowworm of ruby hue descending the incline at the Brooklyn end to the centre and steadily climbing section by section on the up grade to New York. Soon the last section of the indicator burns red and a moment later the train runs into the station, clears the block, and the green light, again showing on the tiny block section, proves that the train is out.

The whole arrangement appears on the face of it to be simplicity itself, and like most other effective devices it is in a sense quite simple, but there are some details which have been worked out in connection with the device which have required considerable skill and judgment. The ordinary track circuit carries an alternating current of about 7 volts. This current operates an A. C. relay which governs the movement of a direct current relay, which opens and closes a D. C. circuit. This direct current is used to operate the electro-pneumatic mechanism which moves the automatic stop at each of the signals. On this D. C. circuit is another relay, which, according to the arrangement for the device, makes and breaks the 60-volt alternating current which is used in lighting the lamps in the indicator and in the signals in the tunnel.

The glow lamps of the indicator are, if one may so say, turned in unison with the home signals of every block, so that when a block is clear the green light of the actual block signal is faithfully reproduced in the green color of the indicator band, which represents that block. When the real block is occupied the home signal shines red and the indicator block, only a few inches long, glows with the same color. This device is in a sense a very perfect scientific instrument. The spectroscope reveals to the trained eyes of science the presence or absence of certain substances in the glowing atmosphere of the sun, and so this tunnel spectroscope makes visible by the alternation of its colored lights the entrance, passage and disappearance of a moving train.

The inception of this unique device is due to Mr. Frank Hedley, general manager of the Interborough system, and the details have been cleverly worked out by Mr. J. M. Waldron, the



INTERBOROUGH TUNNEL INDICATOR. DARK SECTIONS SHOW BLOCKS OCCUPIED BY TRAINS.
(Small white offset lines show telephone stations; longer white vertical lines show positions of signals.)

signal engineer of the company. The device is placed above a telephone switchboard where terminate the wires of about sixty telephones which are distributed through the tubes at a distance of about 300 ft. apart. Chemical fire extinguishers are also placed at each telephone station in the tunnel, and a city water main passes through each tube with hydrants every 300 ft., each supplied with 200 ft. of fire hose.

Not only is there a home and caution signal at the entrance of every block in the tunnel, each equipped with an automatic stop similar to those used on the express tracks of the subway, but the blocks are proportioned in accordance with the grade and the estimated speed of trains either under power or coasting. The longer blocks are necessarily near the lowest portions of the tunnels.

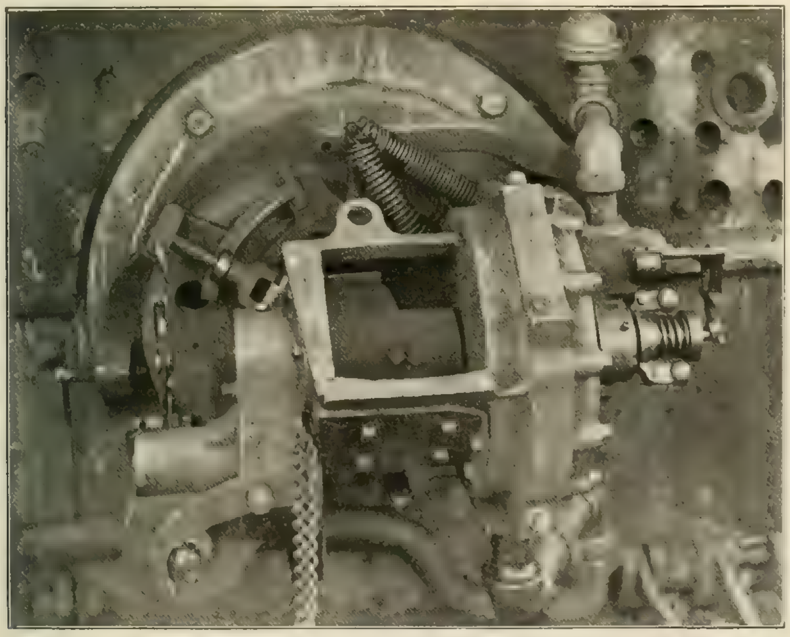
The indicator in the dispatcher's office can thus reveal the particular block occupied by a stalled train and would give such visible information as may enable the dispatcher to block the entrance of the tunnel for all other trains, while the crew of the stalled train would never find themselves more than 150 ft. away from the nearest telephone by which the ear of the dispatcher could be reached. A signal out of order in the tunnel or a burned out glow lamp in the indicator readily becomes apparent. With the correct working of the whole tunnel apparatus one may almost say that sight and hearing are extended through the tubes and are in this way given to the man in charge whose duty it is to watch over the movement of the trains as they pass below the bed of the East River between the sister cities Brooklyn and New York.

Crosby Mechanical Stoker.

In the working of this mechanical stoker on locomotives there are practically three operations. They are the transfer of coal from the tender to the fire door, the application of the force requisite to throw the coal into the firebox, and the operation which consists of properly distributing it.

CROSBY STOKER, VIEW OF THE WORM CONVEYOR.

To accomplish the first operation the mechanism must be so arranged as to be easily and conveniently started and stopped, and it must also be able to furnish a variable supply, according to the demands. The second step is to impart sufficient force to carry the coal into the firebox, varying only in the quantity handled, the variations being arranged for in the conveyor. The last step is constant under fair conditions, but must be easily controllable for varying conditions. It must be automatic for normal conditions and manually controllable for abnormal requirements.

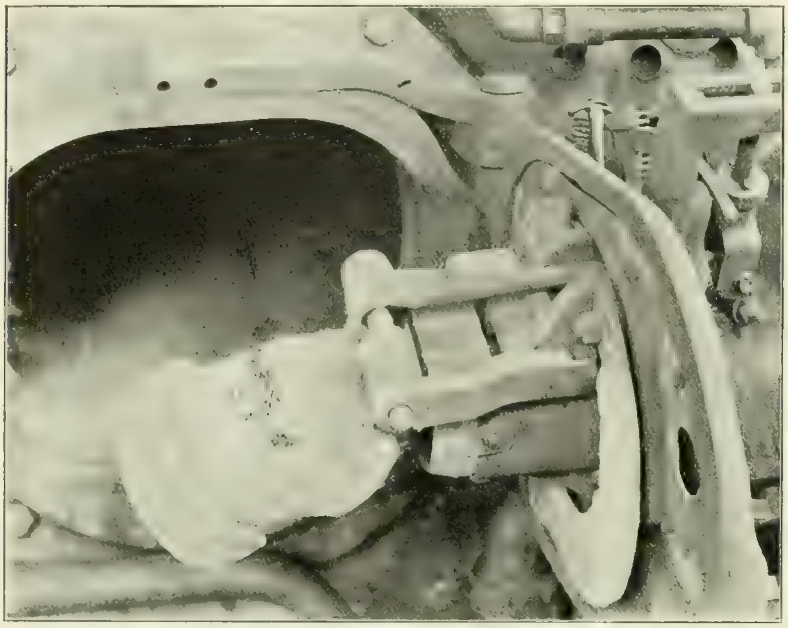


THE DISCHARGING HOPPER IN PLACE.

The transference of coal from tender to firedoor is accomplished by the use of a screw conveyor, extending from the coal space in the tender to the firedoor, and running in a sheet metal trough having a circular bottom and flaring sides. The trough lies upon the bottom of the coal space from the rear end to a point just in front of the coal gate. At this point both auger and trough are so jointed as to provide for the motion of engine and tender due to unevenness of track and on curves. Also to allow the remaining portion of the auger and trough to incline upwards to fire door, and also to allow the trough and auger to be raised to a vertical position, and stand back against the coal gate out of the way when not in use. When in operation the upper end of this member of the conveyor rests in a pivoted saddle upon the stoker proper. The lower section of the conveyor is covered when the tender is full of coal, from its rear end to within a few inches of the coal gate, with plates about a foot long; and as the coal supply diminishes the plates are one by one removed.

The conveyor will handle lumps of coal up to 10 or 12 ins. in size, and will bring it to where the fireman can reach it. When it comes to the joint, or as it passes up the incline it must be broken to about 4 in. lumps. This can be done by the use of a machinist's hammer, and the fireman stands without having to stoop while he breaks the coal. The conveyors thus bring the coal to him for inspection.

Hanging under this upper or inclined section of the conveyor is a case containing a cone gear by which any one of several speeds may be imparted to the screw; or it may be stopped or started instantly at will. The complete control of the screw is secured by a lever placed within easy reach of the operator.



CROSBY STOKER. THE DEFLECTOR ATTACHED.

The throwing of the coal on the fire is accomplished by rapidly revolving steel blades within a small receiving hopper, which are carried upon a "head" similar to that used on a wood planer. The conveyor discharges coal at the required rate into the small receiving hopper, whence the blades gather it, and discharge it forcibly through a round nozzle in the door. Each of these blades discharges one-half of the receiving hopper, as they are offset for that purpose, and are run at a constant speed when in operation.

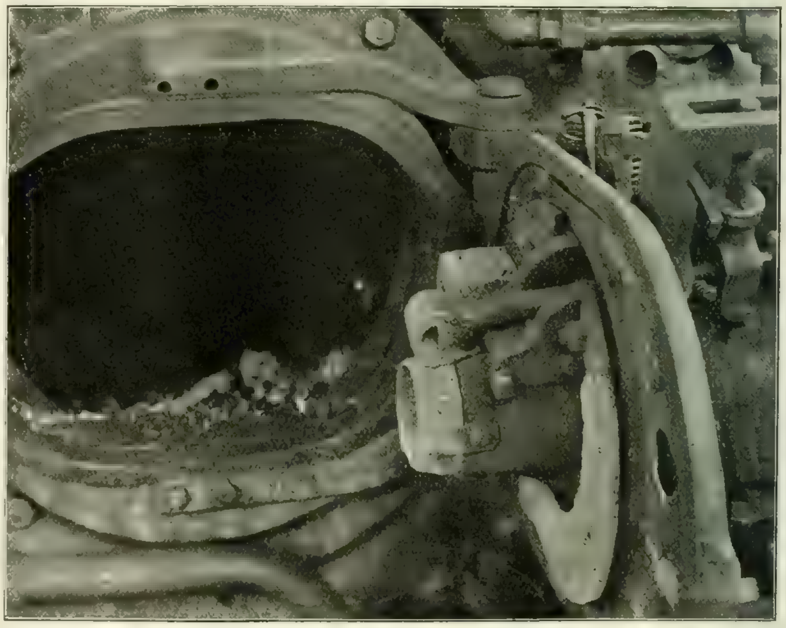
The distribution of the coal is done by moving the deflector as the coal emerges from the nozzle, thus guiding it over the fire box, not all at once, showerlike, but from place to place, until the entire grate is covered, and repeating the operation, each cycle requiring about thirty seconds. This spreading device was not designed only to afford means for scattering coal over wide fire boxes, but to scatter the coal in obedience to the laws of combustion. Starting at the front left corner of the fire box, the coal is deposited in what may be called a "strip," about one-third of the width of the fire box and down the left side, including the back corner. The deflector then with a quick movement shifts and delivers the coal over one-third of the width of the box, beginning at the flue sheet. This covers the middle third, finishing under the door. It then moves quickly, so that the coal may be delivered to the front right corner and down the right side, including the back corner. Then it quickly comes back for delivery to the front left corner, and again repeats the cycle.

A specially designed door replaces the regular fire door, and to this door is bolted a casting which is called the "main frame." It is essentially a two-chamber casting, one of which is covered steam tight by a head. In this steam-tight chamber is mounted a steam turbine disc upon which four small steam jets impinge. In the other chamber is the rotary discharger before mentioned. A shaft runs through both these chambers and carries the turbine wheel and the discharger, thus making a simple, direct connection, with only a thin partition between.

On the right, or turbine end, the shaft projects beyond the journal which carries it, and has mounted upon the projecting end a flyball governor mechanism. Steam is admitted to the governor valve at full boiler pressure and the governor completely controls the speed from no load to full load without attention from the fireman.

The other end of the shaft also projects beyond its journal and carries a spur gear which, in turn, drives a worm gear. This gearing is contained in an oil-tight case bolted to the main frame. The worm driven shaft, running at a suitable speed, projects from this case, carrying a feather key, over which slips the sleeve connection which drives the conveyor cone gear. The other, or inner end of this worm-driven shaft, carries a smaller worm which further reduces the speed for driving the spreader mechanism. This worm may be engaged or disengaged from the shaft by means of a small, and conveniently placed lever, and by moving this lever the spreader may be stopped at any point of its cycle, in order to build up the fire where it may have become weak. This worm and clutch is also enclosed in an oil-tight case extending from and bolted to the other case.

Two of our illustrations show the door standing open, one with the deflector in position and the other with it removed, giving full and free access to the fire box. This deflector can be most easily taken off or replaced, even when hot, in a few seconds. In fact, the entire operation of raising the conveyor and removing the deflector occupies seldom more than thirty seconds. The total weight of the stoker and conveyor is about 900 lbs.



DEFLECTOR REMOVED FOR HAND FIRING.

The entire work of development has been accomplished on the Chicago &

(*Continued on page* 170.)

Items of Personal Interest

Mr. E. E. Chrysler, formerly master mechanic of the Chicago, Rock Island & Pacific Ry. at Chickasha, Okla., has resigned.

Mr. Geo. S. Hunter has been appointed master mechanic of the Kansas City & Southern Railway at Pittsburgh, Kan.

Mr. F. W. Brazier, superintendent of rolling stock on the New York Central at New York, has had his office moved to Albany, N. Y.

Mr. R. Anthony has been appointed locomotive foreman on the Canadian Pacific Railway, with headquarters at Moose Jaw, Sask.

Mr. R. R. Neild has been appointed general locomotive foreman on the Canadian Pacific Railway, with headquarters at Winnipeg, Man.

Mr. T. G. Armstrong has been appointed general car foreman on the Canadian Pacific Railway, with headquarters at Winnipeg, Man.

Mr. P. S. Lindsay has been appointed road foreman of locomotives on District No. 3 of the Central Division of the Canadian Pacific Railway.

Mr. John Howard, superintendent of motive power on the New York Central Railroad at New York, has had his headquarters moved to Albany, N. Y.

Mr. K. L. Dresser has been appointed master mechanic of the Chicago, Cincinnati & Louisville Railway, with headquarters at Chicago, Ill.

Mr. Walter G. Berg, chief engineer of the Lehigh Valley, has been elected president of the American Railway Engineering and Maintenance of Way Association.

Mr. G. T. Neubert has been appointed master mechanic of the Chicago Great Western, with headquarters at Oelwein, Ia., vice Mr. W. P. Chrysler, promoted.

Mr. G. J. Bury has been appointed general manager of the Western lines of the Canadian Pacific Railway, with headquarters at Winnipeg, Man. Mr. Bury was formerly assistant general manager of lines west.

Mr. B. F. Farr, formerly foreman on the Delaware & Hudson Railroad at Mohawk, N. Y., has resigned to accept position as master mechanic on the American Fruit Growers' Railway of Costa Rica, Central America.

Change of Address.

We have to announce to our many friends that after May 1st, Railway and Locomotive Engineering will occupy new quarters. On that date we will be in the Engineering Building, 114-118 Liberty street, New York. Our new location is only a few doors from our present place of business and any of our friends who call upon us will find us on the sixth floor of the Engineering Building. After the first of May all letters should be sent to us at our new address.

Mr. F. J. Ryan, formerly with the McGuire-Cummings Mfg. Co., is now acting as special representative for The Diamond Rubber Co., in its railroad department.

Mr. J. B. Gannon has been appointed master mechanic of the Midland Division of the New York, New Haven & Hartford, with offices at East Hartford, Conn.

Mr. J. C. Reed has been appointed locomotive foreman on the Canadian Pacific, with headquarters at Medicine Hat, Alberta, vice Mr. R. Anthony, transferred.

Mr. P. C. Zang has been appointed master mechanic of the Shore Line Division of the New York, New Haven & Hartford, with headquarters at New Haven, Conn.

Mr. G. W. Lillie, supervisor of the car department of the St. Louis & San Francisco at St. Louis, Mo., has been transferred to the motive power department at Springfield, Mo., on the same road.

Mr. G. J. Hatz, formerly master mechanic on the Chicago & Alton Railway at Bloomington, Ill., has been appointed general foreman on the Union Pacific Railroad, with headquarters at Omaha, Neb.

Mr. R. E. McCarthy, formerly engine house foreman on the Pennsylvania Railroad at Pittsburgh, has been appointed engine house foreman of the Pittsburgh, Cincinnati, Chicago & St. Louis Railroad.

Mr. George J. Hatz, formerly master mechanic of the Chicago & Alton at Bloomington, Ill., has been appointed superintendent of shops of the Union Pacific at Omaha, Neb., vice Mr. H. Stovel, deceased.

Mr. O. R. Hale has been appointed master mechanic of the San Luis Division of the Mexican Central Railway, with headquarters at Aguascalientes, Mexico.

Mr. J. Hocking has been appointed master mechanic of the Boston Division of the New York, New Haven & Hartford, with headquarters at South Boston, Mass.

Mr. F. L. Carson has been appointed master mechanic of the Torreon Division of the Central Mexican Railway at Torreon, Coah, Mex., vice Mr. O. R. Hale, transferred.

Mr. E. S. Fitzsimmons has been appointed master mechanic on the Erie Railroad at Hornell, N. Y., vice Mr. G. T. Dupee, granted leave of absence on account of ill-health.

Mr. W. Sargeant has been appointed acting foreman of the erecting shops on the Grand Trunk Railway, with office at Montreal, Que., vice Mr. R. Cowan, promoted.

Mr. F. B. Edwards has been appointed assistant road foreman of engines on the Chautauqua Division of the Pennsylvania Railroad, vice Mr. H. R. Brigham, promoted.

Mr. Smith J. Daly has been appointed district passenger agent on the Chicago Great Western Railway, with office at 208 Old South Building, Boston, Mass., vice Mr. W. A. Dolan, transferred.

Mr. Geo. S. Hunter, formerly master mechanic of the International & Great Northern, has been appointed master mechanic of the Kansas City Southern, with headquarters at Pittsburgh, Pa.

Mr. T. F. Carbery, formerly master mechanic of the Missouri Pacific at St. Louis, Mo., has been appointed master mechanic on the same road at Ft. Scott, Kan., vice Mr. J. J. Reid, transferred.

Mr. J. H. Carrie, formerly assistant foreman in the Green Island shops of the Delaware & Hudson Railroad, has been appointed foreman on the same road at Mohawk, N. Y., vice B. F. Farr, resigned.

Mr. J. W. Leonard, formerly assistant general manager of Eastern lines on the Canadian Pacific, has been appointed general manager of the Eastern system, with headquarters at Montreal, Que.

Mr. Albert R. Reese, formerly of the Chicago Junction Railroad, has been appointed engine house foreman for the Pennsylvania Railroad, with headquarters at Pittsburgh, Pa., vice Mr. R. E. McCarthy, transferred.

Mr. E. L. Chudleigh, acting master mechanic on the Canadian Pacific Railway at Moose Jaw, Alt., has been appointed train master on the same road at Cranbrook, B. C., vice Mr. J. P. McNabb, assigned to other duties.

Mr. W. J. Monroe, formerly general foreman of the Rock Island lines, has been appointed master mechanic of the Oklahoma Division of the same road, with headquarters at Chickasha, I. T., vice Mr. E. E. Chrysler, resigned.

Mr. W. A. Nettleton, formerly general superintendent of motive power of the St. Louis & San Francisco, has been appointed general superintendent of motive power of the Chicago, Rock Island & Pacific at St. Louis, Mo.

Mr. W. Gell, formerly master mechanic on the Grand Trunk Railway, has been appointed master mechanic on the Grand Trunk Pacific, in charge of motive power, cars and shops, with temporary headquarters at Winnipeg, Man.

Mr. Gamble Patrobe, formerly assistant engineer of the Baltimore Division of the Northern Central Railway, has been appointed acting general agent and superintendent, vice H. W. Kapp, granted a leave of absence on account of ill-health.

Mr. Robert Cowan, formerly foreman of erecting shops of the Grand Trunk Railway at Montreal, has been appointed master mechanic of the Ottawa Division on the same road, with headquarters at Ottawa, Ont., vice Mr. W. Gell, resigned.

Mr. George Hancock, formerly superintendent of motive power on the St. Louis & San Francisco, has been appointed general superintendent of motive power on the same road, vice Mr. W. A. Nettleton, resigned. The office of superintendent of motive power has been abolished.

Mr. George Glassford, district master mechanic on the Canadian Pacific Railway, is at present acting locomotive foreman in addition to his other duties.

Mr. W. J. Spearman has been appointed master mechanic of the Idaho & Washington Northern Railroad, with headquarters at Spirit Lake, Idaho.

Mr. W. G. Hall has been appointed foreman of the Mechanical Department of the Trinity & Brazos Valley Railroad, with headquarters at Tomball, Texas, vice Mr. E. L. Rebuck, resigned.

Mr. F. S. Anthony has been appointed master mechanic of the Gulf Division of the International & Great Northern Railroad, with headquarters at Palestine, Texas.

Mr. T. S. Lloyd, who has been general superintendent of motive power of the Chicago, Rock Island & Pacific for several years, has resigned to become superintendent of motive power and equipment of the Delaware, Lackawanna & Western, vice Mr. R. F. Kilpatrick, resigned. Mr. Lloyd thus resumes the position he held previous to his connection with the Rock Island Lines. His headquarters will be at Scranton, Pa.

The American Society of Mechanical Engineers, with the desire to further develop the publication of their proceedings, etc., have secured the services of Mr. Lester G. French to direct their editorial department. Mr. French was born at Keene, N. H., in 1869, and began his training in editorial work and printing at Brattleboro, Vt., where his father was the publisher of "The Vermont Phoenix." In 1891 Mr. French received his degree in mechanical engineering from the Massachusetts Institute of Technology. After four years' apprenticeship, followed by drafting room and shop experience, principally at the Builders' Iron Foundry shops in Providence, and a year and a half as a text book writer, Mr. French was engaged on the editorial staff of "Machinery," and for nine years was its editor-in-chief.

General Foremen's Association.

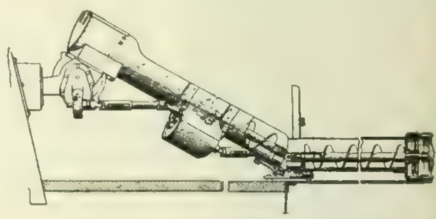
Mr. C. A. Swan, Jr., former president of the International Railway General Foremen's Association, called at the office of RAILWAY AND LOCOMOTIVE ENGINEERING a few days ago. Mr. Swan is engaged in work which keeps him constantly in touch with railroad officials and with railroad foremen, and he has found that a constantly increasing interest in the association is being taken by railroad mechanical department officers, and among the various general foremen the feeling is one of enthusiasm. The papers to be read at the approaching convention are on live railroad topics and a full attendance is expected. Mr. Swan was the first president of the General Foremen's Association, and did a lot of good hard work in the matter of organization and in getting the association into shape after it had been started. Mr. E. F. Fay is president this year, and is supported by a strong executive committee. All this augurs well for the future. The association is an organization which deals with practical railroad shop matters in a practical way and is worthy of support.

Crosby Mechanical Stoker.

(*Continued from page* 168.)

North-Western Railway, of which Mr. Robert Quayle is superintendent of motive power. We are informed by the makers that when on time freight runs between Chicago and Fon-du-Lac via Milwaukee, a distance of 153 miles, the door was opened twice, once at Bain while taking coal and water, 40 miles from Chicago, and again at Milwaukee, 45 miles, while the train was being switched, then on to Fon-du-Lac, 68 miles, with door closed.

Later the stoker was taken to the Iowa division between Clinton and Belle Plaine, and while there made a run of 116 miles with only one and two openings of the door with full steam pressure all the time. Another engine was equipped with a Crosby stoker for use between Chicago and Clinton, 138 miles. This engine gave much trouble on account of leaky steam pipes, but notwithstanding, the stoker made some remarkable showings. On two or three occasions the run from Nelson to Chicago, 100 miles, was made without opening the door; and on



OUTLINE OF THE CROSBY STOKER.

several occasions this included an hour or more of switching en route.

During these tests, fuel economy, not much in evidence at first, was becoming increasingly prominent; until toward the close of the tests seldom ever more than ten tons of coal were consumed for the 138 miles, with a usual tonnage of 1,200 to 1,300 and the time about seven hours. The last trip of the series was the most remarkable of all. The coal out of Clinton was very fine slack, and the tonnage about 1,275 to Nelson, 34 miles, and barely more than two tons of the slack was used; and from there into Chicago six tons of somewhat better coal was used. Two cars of dressed meat were set out at Nelson, the rest were brought to Chicago. During this trip some difficulties arose which interfered seriously with economical operation between Nelson and Chicago, and had it not been for this there is every reason to believe that not over seven tons would have been consumed.

At the close of this series of tests, covering about eight months of uninterrupted road work, the stokers were brought in for some minor improvements that had been found desirable. Seven new machines are now being made at the North-Western shops.

The makers also inform us that stoker-

fed fires are much easier cleaned on the pit than hand-fed fires on account of there being much less clinker. The flues require less work to keep them tight, and smoke is almost eliminated. Brick arches last longer on account of the fact that highest temperatures which occur between fires in hand work do not occur in this class of stoker work, where the feed is continuous, even though the engine is worked harder on the average than with hand fired engines. The fireman's work is reduced by the stoker, according to conditions. The Crosby stoker is controlled by the International Stoker Company, Chicago. The engines upon which this stoker has been tested are N-W, Class R-I. Cylinders, 21x26 in., type 4-6-0. Drivers, 54 ins. Grates, about 66x102 ins.

The Great Pennsylvania Railroad.

An idea of the vastness of the Pennsylvania Railroad system may be obtained from figures in the annual "Record of Transportation Lines," compiled last month by the maintenance of way departments of the system. These figures show a total mileage of 11,080.60, of which 6,154.63 miles are east of Pittsburgh and Erie and 4,925.97 west of Pittsburgh.

The lines penetrate thirteen States and the District of Columbia, the greatest mileage being in Pennsylvania, where the system has 4,067.48 miles of line. Ohio is second with 1,831.13 miles and Indiana is third with 1,541.82 miles. There are 823.06 miles of line in New York and 771.93 miles in New Jersey. Illinois has 635.24 miles, Maryland 552.70, Michigan 435.36 and Delaware 274.05 miles. In the District of Columbia and each of the States of Kentucky, Missouri, Virginia and West Virginia —termini of different parts of the system—the mileage is less than one hundred.

The total trackage of the system amounts to 23,572 miles, of which 13,788 are east of Pittsburgh and 9,784.10 are west of that point. The development of the system to meet the requirements of commerce in recent years is to be seen in the fact that while the mileage has increased only 518.15 since December 31, 1906, the total trackage has increased 3,027 miles. The system at the present time has 3,241.90 miles of second track, 763.28 miles of third track, 551.56 miles of fourth track and 7,934.98 miles of sidings.

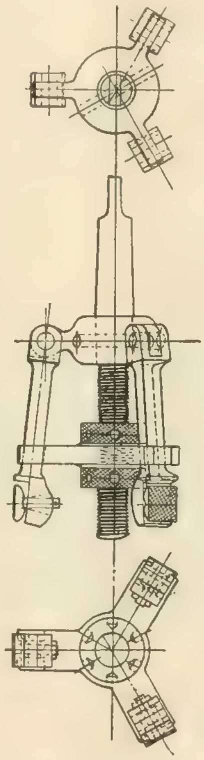
Every day that dawns brings something to do which can never be done as well again. Instead of shirking it or hurrying over it, we should put our whole heart and soul into it.—*James Reed.*

Steam Pipe Ring Grinder.

A very useful shop appliance for grinding rings to steam pipes was recently given in the "Erie Railroad Employees' Magazine," and the illustration of the handy little tool is here reproduced.

An ordinary air motor is used in connection with this tool, and the rings can be ground to pipe by simply lifting up the steam pipe on the floor so that it will be in proper position to get at conveniently. The tool is easily made. It consists of a collar to which are attached three arms. There is a spreader in the centre, which opens these arms as it is forced toward the collar, to which the arms are hinged.

The ring to be ground is placed so that its inside surface is on the three holding faces at the end of the arms, and a few



STEAM PIPE RING GRINDING DEVICE.

turns of the collar arms bring things up tight and the ring is firmly grasped on the inside and held so that it can be turned rapidly by the air motor in the act of grinding. The amount of muscular effort thus saved is very great.

The advantage of this tool lies in the fact that it can be used on the floor of the erecting shop, and it saves labor in carrying steam pipes to and from the machine shop. It also saves the time required to chuck in a machine ready for grinding. This device was first worked out, perfected and put in operation in the Meadville, Pa., shop of the Erie Railroad.

An advertisement is like a woman; it may be pretty or it may be plain, but it isn't a success unless it attracts.—*Poor Richard, Jr.*

Railroad Political Party.

It is reported through the news agencies that a Chicago lawyer is attempting to organize railroad men into a new political party. John H. Clark, counsel for the Nickel Plate System at a public banquet in Chicago, said: "that only one man can stop the anti-railroad legislation rage which prevails, and he is the voter. I believe we should organize railroad men into a compact political party, and I believe a great leader will arise who can effect such a great organization when the call is sounded."

The great difficulty in organizing railroad men to vote down the kind of legislation which people like Mr. Clark regard as vicious, is that the mass of railroad employes take an entirely different view from Mr. Clark and hail as righteous measures which their employers consider tyrannical. The rank and file of railroad employes demand the enactment of a new railroad employers' liability law to make constitutional the law knocked out by the Supreme Court of the United States; but very few of the higher officials sympathize with the proposed change. In spite of the platitudes to the contrary, the interest of railroad companies and of their employes are frequently decidedly in conflict.

Creosote Treatment.

The Department of Agriculture has just issued an important report on the Lumber Cut of the United States, and points out the fact that the supply is falling off while the demand is naturally increasing. This is especially the case with the best kinds of timber, but the report also points out the fact that creosote treatment when applied to the cheaper kinds of wood adds greatly to its durability when used as fence post or sleepers. As is well known among railway men, most of the so-called inferior woods are well adapted to the treatment, and when properly treated outlast the hardest of untreated woods.

The absorption of creosote in ordinary cases varies from two-tenths of a gallon in willow to seven-tenths in pine. In the case of ash, hickory, red oak, elm and maple, the absorption is about four-tenths of a gallon. At this small outlay the durability of the timber is extended to twenty years. In ordinary conditions the same timber will decay when placed in the ground in three or four years.

A correspondent who is smitten with the firing fever thus describes his natural recommendations: I am twenty-one years old, good looking, of fine address, good parentage, sober, honest, truthful, no bad habits. I may say without a personal fault, or thought of fault. Do you think there is a place for me on the iron horse?

Strength of Tubes and Flat Sheets.

By Sidney C. Carpenter

In the following article I have dealt with some of the principles which apply to the strength of tubes subject to external pressure and of flat sheets, such as fire box sheets.

Fig. 1 illustrates the action of the steam pressure on the flues of a locomotive. Though the steam does not act directly upon them, the pressure is transmitted through the water so that they receive the full force of it. If the tube is exactly round, the pressure is equal on all

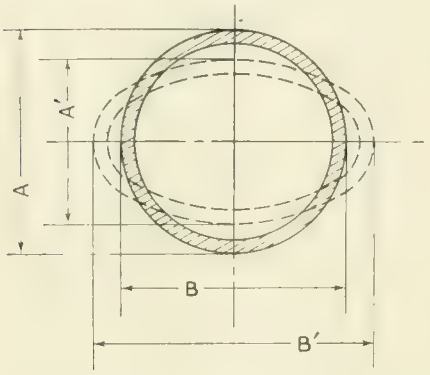


FIG. 1. TUBE SECTION.

sides, as at A and B, but the slightest deviation from a true circle destroys the balance, as shown, exaggerated, by the dotted oval. Now the pressure on B', tending to flatten the tube, has not only become greater than the pressure on B, but the opposing pressure on A' has become less. The difference between B' and A' is the force tending to collapse the tube, and any increase in the eccentricity of the tube greatly increases this force. Therefore a tube subjected to external pressure is very unstable and should be made much stronger than if it were designed for internal pressure.

The collapsing pressure for a wrought iron tube may be found approximately as follows: Square the thickness of the tube and multiply by 9600000; divide the result by the length, multiplied by the diameter. For the safe thickness, multiply together the length, diameter, pressure per square inch and a suitable factor of safety, and divide by 9600000, and then extract the square root of the result.

If the oval shown, in Fig. 1, were subjected to internal pressure, the force on the long diameter would be greater than on the short diameter and the tube would be forced back into the form of a true circle, as the finger of a glove becomes round and stiff when you blow into it. This principle is made use of in steam gauges, where the pressure in the flattened and curved tube, tends to straighten it out.

The film of water in a soap bubble blown up from a pipe is a good illustration of the action of a flat sheet under pressure. The film is flat as it lies across the bowl of the pipe, but when blown up it bulges out and assumes a spherical form. The fire box and tube sheets of a locomotive tend to act in the same manner and there are two ways of preventing them from doing so. They may be made thick enough to be self supporting, or thinner sheets may be used and the inner and outer shells fastened together at intervals.

The different sheets of a fire box, being fastened together along their sides, may be considered as plates supported at the edges. To find the thickness of such a sheet, if no staybolts are used, we will take, as an example, a sheet 60 ins. square, having a tensile strength of 8,000 lbs., and subjected to a pressure of 200 lbs. per square inch. Take half the length of one side of the square and multiply it by the square root of the pressure divided by the tensile strength of the sheet.

$$\frac{60}{2}\sqrt{\frac{200}{8000}} = 4\tfrac{3}{4} \text{ ins. nearly.}$$

As such a thickness is out of the question, we must use a thin sheet and staybolts. The size and material of the staybolts may be assumed at once. We will take iron bolts, 1 in. in diameter at the root of the thread.

The total area to be braced, Fig. 2, is 60 $\times$ 60 ins. = 3,600 square inches, and the pressure is 200 $\times$ 3,600 = 720,000 lbs. It is evident that the fewer the number of bolts used, the more strain each one must bear and we may set the limit at 6,500 lbs. per square inch. The area of a 1 in. bolt is .7854 sq. in. and 6,500 $\times$ .7854 = 5105.1 lbs., which is the greatest strain we can allow on each bolt. Call it 5,100 lbs., then 720,000 $\div$ 5,100 = 142 staybolts which must be used; say 144, with 12 on a side. The pressure per square inch on the plate is 200 lbs. and, as the pressure each staybolt can carry is 5,100 lbs., the area supported by each bolt is 5,100 $\div$ 200 = 25.5. As can be seen at A in Fig. 2 each bolt supports a square section of the plate and one side of this square is equal to the distance between the bolts, or the "pitch." The area has been found to be 25.5 sq. ins., and one side is equal to the square root of the area, or about 5 ins.

Considering the strain on the staybolts alone; 142 bolts, spaced 5 ins. apart will be satisfactory, but we must also consider the thickness of the sheet in connection with the pressure on the surfaces between the bolts. The sheet must be thick enough to stand this pressure or it will bulge. We can calculate the thickness of a sheet for a given spacing of staybolts, or we can assume a reasonable thickness and design the spacing by the rule given below. This will be a check on the result of the method just illustrated. The rule which gives the greatest area of plate which can be safely supported by one stay is as follows:

For plates up to 7-16 in. in thickness, multiply 112 by the square of the thickness of the plate in sixteenths of an inch and divide the product by the steam pressure in pounds per square inch. For plates above 7-16 ins. in thickness, use 120 instead of 112. When screw staybolts are fitted with nuts inside and outside of each plate, use 140. The pitch of the stay will be the square root of the area found by the above rule.

Assuming a ½ in. sheet, we have

$$\frac{120 \times 8^2}{200} = 38.4 \text{ sq. ins. for the area}$$

and the pitch equals 6.2 ins., so that we are well within bounds if a 5 in. pitch is used. If the plate were ⅜ in. thick, the area would be 21.6 sq. ins. and the pitch would be 4.64 ins. In this case, if it were impracticable to use a thicker plate, the number of stays should be increased and the proper number could be obtained by dividing the total area of the plate by the allowable area for one stay. This would be 167 for a plate 60 ins. square.

The foregoing methods apply to cases of direct staying, such as water legs, and the crown sheet of Belpaire fire boxes, where the stays are at right angles to the surface of the sheet. It can also be applied to the spacing on the crown sheet when radial stays are used.

Staybolts cannot always be spaced with perfect regularity and the arrangement must often be modified to allow for riveted joints, attachment to the shell, etc., but in no case should a staybolt be allowed to strain greater than calculation

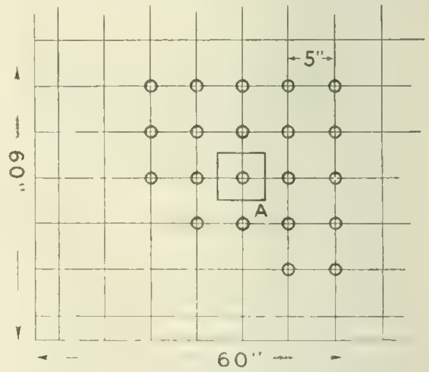


FIG. 2. SURFACE OF THE SHEET.

shows to be safe. One bolt breaking throws increased strain on adjacent bolts and if another gives way the strain is still further increased. Another point which is often taken into account is the fact that the flanging of the edge strengthens the sheet for a distance of about six times the thickness, or 3 ins. for a ½ in. sheet

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We have several times recently received applications from railroad men for a book that would help them to manage stationary engines and power plants. Hemenway's "Catechism of the Steam Plant" is a mass of useful information crowded into the smallest possible space and sells for fifty cents.

Heavy Four Side Molder.

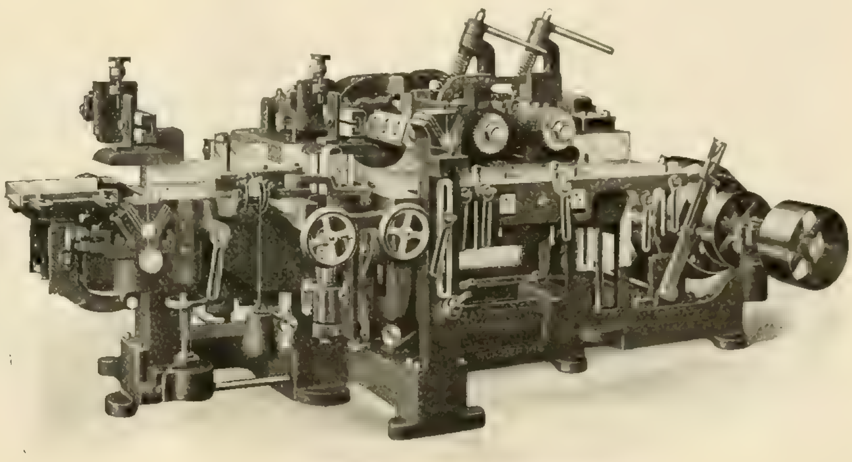
The machine shown in our illustration is manufactured by the J. A. Fay & Egan Co. of Cincinnati, O.

The frame is a heavy cast iron structure built up and mounted on a substantial sole plate made extra long to insure good belt service. The bed is raised and lowered by powerful screws mounted on ball bearings. It drops to the depth of 14 ins., and is securely locked at any position. The section of the bed behind the lower head swings down out of the way to give access to the head. All adjustments of spring posts, side heads, etc., are made by hand wheels and locked in position with lever nuts. The cutter heads are of crucible steel, four sided and slotted on each side. The upper head has adjustable, detachable outside bearing with an upright column extending from the floor. The lower head has vertical and lateral adjustments.

Sectional clamp bearings are applied to both the upper and lower cutter-head spindles on this machine. These bearings consist of metal plates held in position by clamp bolts, which exert no downward pressure on the journals, and which cannot be screwed tight enough to bind. Any wear can be quickly taken up by releasing the clamp bolts and simply pressing the plates down with the hand. This device insures a cool running journal.

The chip breaker is adjustable, and slides back out of the way, the pressure bars behind the upper and over the lower head both swing up out of the way, and the device is so arranged that without readjustment it will return to its original position. The side heads are mounted on the table and have independent, vertical, lateral and angular adjustments, all of which can be made from the front of the machine. The outside head is fitted with an improved weighted matcher clip, and the fence is arranged to move simultaneously with the spindle and head. The feed consists of four powerfully geared rolls, the two upper ones are in sections and the two lower ones are solid. The upper rolls are both driven down, which makes it easy to attach a patent spring hold-down, thus giving an even pressure on the material.

The machine is designed for extra heavy molding, and is made in two sizes, one for 12-inch and the other for 14-inch material. The manufacturers will be happy to give further information concerning the tool to those interested.



HEAVY FOUR SIDE MOLDER.

The Era of the Steel Car.

At a recent meeting of the New York Railroad Club, Mr. Arthur M. Waitt read an exceedingly interesting and instructive paper on "The Era of Steel and the Passing of Wood in Car Construction." Among other things, he spoke substantially as follows: Car development from a very primitive wooden vehicle of 10 tons' capacity to the modern one of almost exclusively metal construction has been rapid, and yet it has developed only by steps. The substitution of metal for wood came gradually, necessitated by the rapid wear and frequent breakage in service of parts that were too weak for the duty demanded of them. The modern steel car was not created full-fledged and perfect by the mind of the gods as was the goddess Minerva by the power of Jupiter. It has been developed by means of the plodding, persistent study and work of the human minds and human hands of the master car builders, whose ruling motto was, to do with their might whatsoever their hands found to do.

The speaker glanced briefly at the history of metal car building and went on to say:

"At the present time there are three distinctly different theories and systems

in connection with the design for steel cars, each supported by able advocates. With one system the designers endeavor to carry the load on the side sills, using the center sills for buffing only. Another school of design endeavors to distribute the load nearly equally over all the sills. This design necessitates a somewhat heavier construction of car than the former. The third school of designers, which have the support of several car builders, endeavor to carry the load largely on the center sills, which are made very deep (even up to thirty inches); the center sills thereby not only carry the load but are also exceptionally strong to resist buffing. With the rapid introduction of steel car framing and its permanence in future practice, it seems at this time desirable as far as possible to eliminate the present great diversity of designs; for such diversity makes it impossible to keep the necessary parts in stock, for interchange repairs in the shops and repair yards of the various roads in the country. Not only is it desirable to simplify and eliminate this great diversity of design, but there are also many strong arguments for working toward a body framing in freight cars, which will permit of an underframing that is interchangeable for box cars, gondolas and flat cars. The system of body framing which carries the load largely on the center sills seems to have a basis which will readily make it possible to have the body framing interchangeable as above suggested.

"It seems perfectly feasible at this time to adopt as recommended practice and later as standards some rolled and pressed sections, at least in the main members of the body framing. A move in this direction would before long be felt in increased simplicity and economy in interchange repairs. It would seem even possible at this time to adopt standards in lengths and widths for steel box, gondolas and flat cars, and then as a natural sequence many standard shapes and sizes would follow. It would be also practicable to standardize many of the rolled sections for angles and channels which are used in the superstucture of many styles of cars now being constructed.

"In the construction of gondolas and flat cars, except where such cars are likely to be used in service for hot cinders, hot billets, or some similar lading, it would seem to the writer the wisest policy to use a wooden flooring rather than steel. With now some ten years of extensive use of steel underframe and all-steel freight cars the earlier arguments in favor of their almost universal adoption have been strengthened and broadened. Even if the lumber supply was likely to be ample in the future, there can be little justification in perpetuating the wooden car, either by large continued expenditures for the maintenance of light capacity cars or by ordering cars with a wooden body framing for present or future use.

"Observation and inquiry made by the writer in Europe during his several recent visits, has shown that the use of steel underframing for passenger equipment is now quite general both on the Continent and in Great Britain; but the use of practically all-metal construction has been quite limited in the past, abroad as well as in America.

"Very satisfactory designs have been developed for baggage and postal cars, as well as for suburban and regular passenger service, and within the past year also for Pullman sleepers. It is yet too early to predict the outcome, but it seems to the writer that in the future development of the designs for steel passenger equipment cars there may be a happy medium arrived at, and generally adopted, where the underframes and the superstructure framing will be of metal, but a reasonable use be made of wood or some fireproof substitute, other than metal, which will permit of a decorative treatment that is more pleasing to the eye than is the case where thin metal is used, and which will also have all of the reasonable and necessary elements of safety for those who entrust their lives in such cars."

Triples and Brake Hanging.

We have recently received copies of three pamphlets, which have been issued by the Westinghouse people for distribution among those interested in the matters treated of. The first is instruction pamphlet T-5033; it deals with type M triple valve. This triple is of the plain automatic "pipeless" type, intended for use on electrically propelled vehicles. The construction and use of this valve is fully explained and illustrated in a neatly printed booklet of 20 pages issued by the Westinghouse Traction Brake Co., of Pittsburgh.

The second pamphlet is No. 5034. It explains and illustrates the L type of triple, which is used on steam railroads in connection with high speed brakes. This triple is of the quick-action, automatic, "pipeless" type, and forms part of the LN passenger car equipment. This instruction pamphlet is issued by the Westinghouse Air Brake Company of Pittsburgh, Pa.

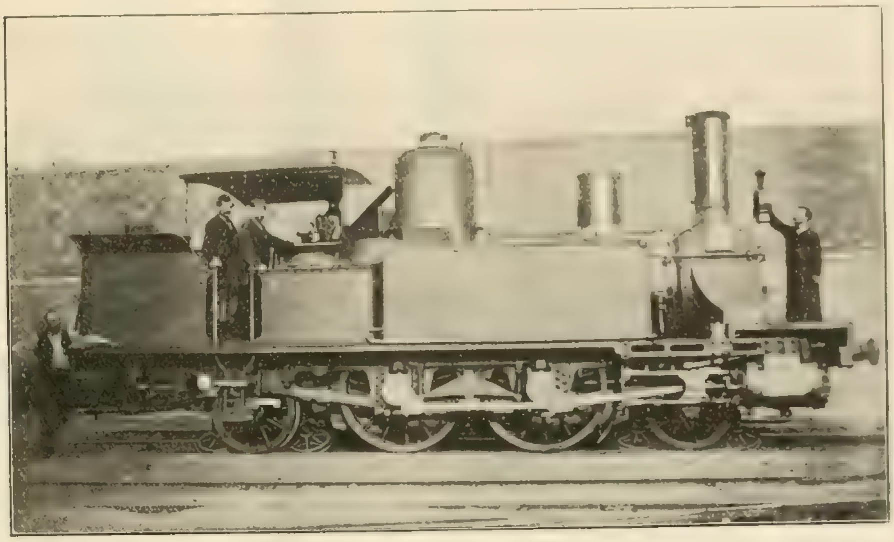
The third pamphlet is a reprint of a paper read some years ago by Mr. R. A. Parke before the New York Railroad Club on "The Effect of Brake-Beam Hanging Upon Brake Efficiency." The whole subject is very fully covered, and numerous diagrams illustrate the authors' remarks. This paper as now issued is Publication No. 0005, and it or either of the others or all three may be obtained by writing direct to the Westinghouse Air Brake Co. and designating the copy or copies desired.

Early Parisian Suburban Railway.

By A. R. Bell.

There existed in Paris until 1891 one of the most curious railways ever constructed. This line, known as the Paris, Sceaux & Limours Railway, was opened in 1848 and ran at the time from a point just under the fortifications of Paris through the suburbs of Sceaux to Limours, a distance of 40 kilometres. The line had many peculiarities, the chief being its gauge of 5 ft. 8¾ ins. and the fact that the engines and carriages had flanged carrying wheels running loose on their axles, and guide wheels set obliquely inside the framing.

The line was originally worked by inside cylinder single engines, which passed into the possession of the Paris-Orleans Railway when they became owners of the line in 1866. As mentioned above, the carrying wheels of the engines ran loose on their axles, and the whole train represented an articulated system. Until a few years ago one of these single engines was employed for driving machinery in a repair shop close to the Paris terminus.



SUBURBAN ENGINE WITH OBLIQUE GUIDE WHEELS ON INSIDE OF RAILS.

Fifteen engines in all were constructed, and our illustration of No. 13 shows one of the last to run, which survived the rest in a rebuilt state and was then employed for working the unavoidably sharp curve near Sceaux. These engines, as will be seen, were "double enders," the leading and trailing ends being fitted with guide wheels. The chief dimensions were: cylinders, 15¾ ins. by 23½ ins.; driving wheels, 4 ft. 10½ ins. diameter; leading and trailing, 3 ft. 4 ins. diameter; boiler diameter, 4 ft. 4¾ ins.; total heating surface, 1,242 sq. ft.; grate area, 15 sq. ft.; boiler pressure, 113 lbs. per sq. in.; weight in full working order, 49 tons; the drivers carrying 25 tons. The valves, which were on top of the cylinders, received their motion through the medium of rocking shafts from eccentrics which were placed inside. The steam brake had two vertical cylinders operating the brake blocks, which were on the upper halves of the coupled wheels. These engines were very smart in appearance, the boiler lagging and dome casing being of polished brass. On gradients of 1 in 100 these engines, with a goods train of 295 tons, attained a speed of 19 miles per hour. To ensure the engines starting well, the sand pipes ended in fan-shaped nozzles to distribute sand on both ordinary and guard rails at the circular stations.

Curious Old Train Rules.

There are some curious rules in the old codes of instruction for train men. In a book published by the Allegheny Railroad in 1869 the following rule is found: It is the duty of conductors to require of the engineer attention to the Rules of the Road. Negligence or recklessness on the part of the engineer will be taken as proof of the inefficiency of the conductor, unless such conduct has been duly and distinctly reported on every occasion of its taking place. He will, at the same time, treat the engineer with that consideration due to his very responsible duties and will always advise with him in case of difficulty.

A very complete catalogue and price list of packing has been issued by the Crandall Packing Company of Palmyra, N. Y. This company makes steam, gas, air, ammonia and hydraulic packing. Each page is devoted to one style, which is illustrated by an excellent half-tone, showing the packing ring cut diagonally so that the interior is laid bare. The style, size, use and price are given, which is all the information necessary for ordering. Sheet packing is shown on the last pages of

the catalogue, and the whole has been most artistically got up. The company will be happy to send this catalogue to any one who applies to them direct. The head office and factory is in Palmyra, N. Y., but there are branch offices in New York, Chicago, Cleveland and Seattle.

First Railroad Project

Of all the old inns now on Second street, Philadelphia, the Bull's Head, now much changed from its appearance a century ago, has the most noteworthy history, for here was shown to inventors and others interested the plans for the first railroad ever constructed in this country. This was not a steam railroad, for at that time the locomotive had not been invented, but it was simply an easy way for wheeled vehicles drawn by horses, which Thomas Leiper had in mind, to connect his stone quarries at Crum Creek with those at Ridley Creek.

It is interesting to note that the man who executed this historic plan was John Thomson, a native of Delaware County, whose son, the late John Edgar Thomson, was president of the

ENGINE OF AN ARMORED TRAIN.

Pennsylvania Railroad Company. The engineer of the railroad was Reading Howell, who designed the plan executed by Thomson. This plan was deposited with the Delaware County Institute of Science. Leiper's railroad answered every expectation and similar railroads were in use in several parts of the State long before steam locomotives were introduced.

The Baldwin Locomotive Works and the Westinghouse Electric & Mfg. Company have just issued a comprehensive catalogue of electric locomotives for mine and industrial service as manufactured jointly by these two concerns. The electric features are Westinghouse Electric and the mechanical features are Baldwin. The numerous illustrations in the catalogue show the extent to which these locomotives are used. The testing plant in the Baldwin Locomotive Works is shown. This is similar to the testing plant used at the St. Louis Exposition. This plant enables a complete record to be made of the performance of every locomotive before it leaves the works.

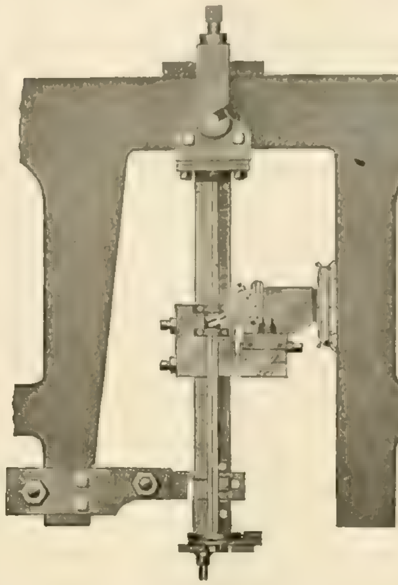
Considerable space in the catalogue is devoted to the rating and performance of locomotives, and "hour rating" and "continuous capacity" are fully discussed. It is claimed that the Baldwin-Westinghouse locomotives are designed with particular reference to their "continuous capacity," experience having demonstrated that equipment thus rated is the least expensive for maintenance. The last two chapters are devoted to Gathering locomotives and Traction reel locomotives. The latter type is provided with a hooked steel cable which winds about a vertical reel, driven by means of a small independent motor. A separate controller starts the reel motor and the cars are hauled towards the locomotive, which itself remains stationary with brakes set. Copies of this catalogue may be had on application to either of the companies.

A press dispatch from Chicago states that the Pullman Palace Car Company recently distributed $174,850 among 3,770 employees of its car service department. The bonus amounts to one month's salary for every conductor and porter who continued on the pay roll of the company throughout 1907 and escaped demerits. The maximum number of porters employed during the year was 4,400 and conductors 1,689. It is the intention of the company to grant the bonus of one month's pay each year hereafter to such conductors and porters as make a clean record throughout the year.

Do you know what "Ruberoid Roofing" is? There are two ways of giving information about a thing like this: one can say what it is, and also what it is not. Well, the company's circular tells us this roofing is made of the best felt with every fiber saturated by a patent elastic compound which the Standard Paint people call "Ruberoid." The ingredients, we are told in the company's circulars, do not contain tar or oil, yet is waterproof and heat-proof and cannot be ignited by hot cinders. Brine will not affect it and it is also alkali-proof. It is used for locomotive cab roofs, car roofs, roundhouses and station roofs. In fact we may say in general that anything that can be roofed can be covered with Ruberoid. Write to the Standard Paint Company, of 100 William street, New York, and ask them anything you want to know about this roofing, and they will be happy to tell you.

Machine for Facing Pedestal Legs.

The practical points of this frame pedestal facer, are, as one may say, self-evident. At the top of the square bar is a steel swivel, allowing the cutting tools to be placed for either leg. There is also a swivel to allow for the



FRAME JAW FACER.

sloping side of the jaw. The top of the swivel has a large surface, which can be clamped to the frame, and is easily changed to allow the device to work on narrow spaces. On one side of the square vertical bar or slide for the milling head is a steel square-thread feed screw. The milling head has a bronze half-nut, engaging the feed screw by a ratchet and pall for change of feed. The feed is operated by an eccentric on the milling head, driving the vertical shaft and making it automatic and variable to suit requirements.

As the milling head has two adjustments, to and from the leg, and across the face, it allows fine and quick adjustment without loosening any part. At the lower end, the universal adjustable clamps hold the device firmly and rigidly to the frame.

A suitable crank is furnished with it, and power is applied to gears turning the milling spindle. This is threaded to receive the milling cutters, which are made of square high-speed steel, and are removable for grinding and adjusting. The means of applying the power is by a telescopic shaft, having universal tumbling joints at each end, which allows the power to be placed in a convenient and out-of-the-way place. A large quantity of metal can be removed in a short time, not by one pass, but by taking light cuts, as the time consumed in each transit is very short. A very complete rig for driving this and other Portable Tools is the Two Cylinder Air or Steam Motor, which in itself is an admirable machine. These machines are made by H. B. Underwood & Company, of Philadelphia, Pa.

Long Railways.

One of the most ambitious enterprises advocated and supported by many public men in North and South America is the construction of a Pan American Railroad to extend in an unbroken line from Alaska to Patagonia. A considerable part of what would constitute the line is already in operation, extending from Canada into southern Mexico. The completed line would be about ten thousand miles long. It would be a tremendously long stretch of unbroken rail travel, but it is certain to be given to the world some day.

A small rival to the Pan American Railway is a line now under construction in Africa to connect Cairo with Cape Town. This line will be about 4,500 miles long when completed.

Improved Dinner Pail.

Railroad men who have no liking for the cold meals that necessity compels them to eat may be interested in a home made fireless cooker, described by Consul Morgan of Amsterdam. He says that a simple device for cooking foodstuffs without fuel has been in general use in Holland for the last two years among the working classes of people. The device consists of a wooden box, padded with hay to a

HEAD-ON VIEW OF AN ELECTRIC

thickness of about 2½ inches on the sides, bottom and cover. The box can be made of any dimension required. The food, after being partly cooked, is placed on hot plates in an enamelled utensil made of a size to fit snugly against the upholstering of the box. The lid of the box is then closed, and the heat generated by the partly cooked food not only continues the pro-

cess of cooking the food thoroughly, but keeps it warm for hours. The cooker is not protected in any way by patents.

The Standard Steel Works of Philadelphia, Pa., have just issued their latest catalogue concerning springs. The first few pages give a brief description of the works and state the method of testing the springs made there before any of them leave the works. The illustrations are artistic and beautifully printed half-tones, one on a page, with brief description below each. The springs range from heavy locomotive driving springs to draw springs and freight car bolster springs, coil and volute springs, and a standard safety spring intended for the protection of passengers on elevated roads. Springs, heavy and light, are enumerated in this catalogue and at the back there are several very convenient "dimension sheets," which are supplied to customers to facilitate ordering. The catalogue, however, will be sent to any one who applies direct to the company, Harrison Building, Philadelphia, Pa.

Old Tremendous Enterprise.

To-day it takes a traveler by rail about 36 hours to go from New Orleans to Washington.

A book on internal improvements of the United States, published in Philadelphia in 1835, says concerning railroad projects in Louisiana: In the Legislature of this State a bill was lately introduced in which the most magnificent scheme of internal improvement ever contemplated was submitted. The bill proposes the incorporation of a company with a capital of $20,000,000, to construct a railroad from New Orleans to Baton Rouge, St. Francisville and Clinton, thence eastwardly to the boundary line of Mississippi. It is recommended as part of a great route through Mississippi, Alabama, Georgia, North and South Carolina and Virginia to Washington City.

One of its advocates affirms that if these States will pass laws to authorize the construction, companies will be formed for continuing the road, so that within twenty years a trip from New Orleans to Washington will not occupy more than six days.

The Michigan Lubricator Company, of Detroit, Mich., are manufacturing a lubricator containing a new oil saving device. It is extremely simple both in construction and operation, consisting merely of a ball float working freely in a cage. The float is so made that it rises and falls with the water level in the lubricator cup or reservoir, always remaining below the level of the oil, but at the surface of the water when the reservoir contains both oil and water, as it usually does.

The philanthropic arrangement that has lately been made by the Southern Pacific for the distribution of second-hand magazines and newspapers in the lonely regions along the company's lines in the Southwest is not confined to the employes of the company, but is intended for the benefit of the people in general. Mrs. Rosine Ryan, the custodian of books and papers in the general passenger agent's office, reports that during the first week she sent out 1,500 papers and pamphlets to 32 section foremen, and that the foremen have distributed this matter among 376 families.

Who Are the Bosses?

"Bosses generally spring from humble surroundings, and as a preliminary have been thoroughly bossed themselves." These were the words in which Mr. Geo. A. Post began his address on Who Are the Bosses? at a recent meeting of the Central Railway Club. He went on to say that bosses came into the world, just as helpless as any other infant, and have to go to school like other boys, but they have "sand" and are not afraid of doing a big day's work. They are not afraid that they will do more than some other fellow who gets the same pay. They keep their eyes and ears open. By and by these fledglings become bosses. They know every inch of the way they have trodden. The speaker was careful to observe that not every man who deserves to be a boss gets to be one, but few achieve the position of the boss unless they have done something to differentiate them from their fellow-workers.

Mr. Post then gave some interesting particulars concerning the early life and work of men prominent in railroad life to-day. He said:

"Besler, of the Jersey Central, began as a trainmaster's clerk—surely a most prosaic beginning. He learned how to operate a railroad in its utmost detail, and that's why he's operating one now. Besler worked.

"Caldwell, of the Lackawanna, in his thoughtful dissertation on the interdependence of railway departments, gave abundant proof of the reason why he did not stay anchored as a clerk in an auditor's office. There's no mystery about Caldwell.

"That masterful personality, Deems, looks now as though he always wielded a sceptre, but he didn't. It wasn't long ago that he wore a 'jumper,' looking after a roundhouse out West. But inside of that 'jumper' was a natural, born jumper, and he jumped, and he landed, too.

"Away down in Shreveport, Louisiana, not many years ago, the name of the station agent of the Texas & Pacific Railway was Newman. Shreveport is there yet, but Newman isn't. Now he is president

of more railway corporations than I have time to mention.

"Facing the blizzards of the Northwest, as he trod the icy tops of the freight cars in the winter, there was once a broad-shouldered, sturdy brakeman, named Underwood. He isn't a brakeman now. He's president of the Erie.

"Throwing wood on to a locomotive tender and working as a section hand are both mighty good exercises, but there must be something besides muscle about a young fellow who began his career by doing these things, and who has fought his way up to be second-in-command of the New York Central lines. Brown accomplished that.

"When you read about Mellen, of the New Haven road, one of the truly great men of the railway world, equally at home whether discussing railway problems in the White House, addressing public assemblies, or planning gigantic schemes of transportation—it requires a stretch of imagination to think of him as once a cashier's clerk on a little New Hampshire road, with his brow corrugated by no greater problem than to make the accounts of his inconsequential office balance.

"To be a printer's devil is not such a coign of vantage as to give a boy any undue advantage over other boys in the race for professional or financial primacy. But that was where Baer, of the Reading, started from. His career tells a story of energy, study and action that ought to make every printer's devil in the country itch with ambition.

"Outfitted with an ordinary common school education, plus horse sense, pluck, and an extra ladleful of gray matter, Truesdale, of the Lackawanna, has winged his flight from a hard-bottomed chair as a clerk to the sumptuous quarters of a railway presidency.

"Finley, of the Southern, originally a stenographer, evidently took notes mentally of what was going on about him until his mind became a veritable storehouse of useful information. He became a student of traffic tariffs, and by natural evolution became an authority upon transportation subjects.

"McCrea, of the Pennsylvania, rising from a rodman in the engineer crops, is now possessed of plenary power which can only be vested in a mental giant, such as he is.

"To every office boy who does the errands and performs the drudgery of that lowly station, the story should be told of Harris, of the Burlington, now the big boss of one of the biggest of railway systems, who started in life as an office boy."

It is a thing of no great difficulty to raise objections against another man's oration—nay, it is a very easy matter; but to produce a better in its place is a work extremely troublesome.—*Plutarch.*

The H. W. Johns-Manville Co. are meeting with much success in the introduction of their new system of lighting known as Linolite. The electric lighting system has been known in the past only in the bulb form, but the new method of stretching a line of light has under many conditions superior advantages. This is particularly the case where the light is required to be concentrated over a comparatively confined area, and is especially suited to work on fine machinery. In the matter of ornamentation it is singularly attractive. Descriptive catalogues may be had on application at the company's offices, 100 William street, New York.

Tie Material in Oregon.

One of the most loudly reiterated complaints about the destruction of our forests puts the blame upon the increasing demand for railroad ties. In some parts of the country timber continues to show little mark of the woodman's axe.

The Government warnings as to the exhaustion of the forests of the country cause little concern in Oregon, which reports 300,000,000 feet of standing timber, more than any other State in the Union, and one-sixth of the entire supply of the United States. At the present rate of consumption, not allowing for any new growth, Oregon's timber supply, it is estimated, would last one hundred and fifty years. The most productive area lies west of the Cascades, where the average standing timber is 17,700 feet to the acre, but many tracts are found that yield 50,000 feet, and single logs that in the form of sawed lumber are worth from $50 to $100 are reported to be commonplace. Federal withdrawal of extensive forest reserves and the State's new laws for the protection of its forests are depended upon to prolong indefinitely the existence of Oregon's timber supply as its principal source of revenue. A dispatch says that there is enough timber in Oregon to build a solid board fence fifty feet high around the entire United States.

A very useful shop tool for railroads is the Buckeye Heater. This is practically a portable blowpipe which gives a very powerful flame of 2,500 degs. Fahrenheit. The flame can be directed on any piece of metal, so that only the part required to be worked will be heated. This saves time and fuel. The fuel used in the Buckeye heater is kerosene and it is finely sprayed and burned in connection with compressed air. It is surprising the number of uses to which this concentrated heat-producer can be applied, among which may be mentioned steel car repairing, taking off driving tires, straightening bent frames, boiler work, skin drying of foundry moulds, etc., etc. There are three sizes which may be briefly described as having

respectively flames 15, 20 and 25 ins. long. A modification of the heater is that made for burning off paint, which has a flame 12 ins. long, the fuel for which is gasoline. The Buckeye heater can also be used as a light by the addition of a light burner, chimney and standpipe, and in this form it is useful for any outdoor work at night and at wrecks. The makers are Walter Macleod & Co., Cincinnati, O., and they have issued a very comprehensive catalogue showing the heater, light and paint burner applied to a great variety of uses. The catalogue is sent free on application.

Train Wreck in India.

Our reproduction of a head-on collision is taken from the *Illustrated London News* of Feb. 8. It gives in graphic form the result of the impact of two trains coming together at speed. The wreck occurred in India and involved the loss of many lives. In the foreground of the picture may be seen the heads of the awe struck natives who gathered around the spot. The British officials are close to the wreck. The accident took place last December, 1907.

HEAD-ON COLLISION IN INDIA.

(Reproduced from the Illustrated London News.)

The largest gas engine in the world has recently been put into operation in the Edgar Thomson plant of the Carnegie Steel Company. The engine weighs 750 tons, is 86 feet long and develops 5,000 horse power. The engine was designed by the Carnegie and Westinghouse engineers to use the waste gas of the blast furnaces, which it is doing successfully. The saving in the cost of fuel will be very great.

The officials of the Chicago, St. Paul, Minneapolis & Omaha took a rather peculiar means of reducing operating expenses and it seems to have worked like a charm. General Superintendent Trenholm said that during January the employes, by economy, had saved the road $160,000, of which $38,000 was on coal. Last October Trenholm made a personal appeal to the employes for their assistance, saying a reduction of wages must occur unless expenses could be reduced.

A great many unsuccessful attempts have been made to apply turbine engines to locomotives, the great power required in starting a train being a difficulty that makes the turbine of little use. For other engineering purposes the turbine engine is rapidly demonstrating its utility. The comparatively small space occupied by turbine engines make them pretty well adapted for torpedo boats, and, as might be expected, they are found highly efficient in such boats.

A very artistic and well illustrated catalogue from the Power Specialty Company of New York has just come to hand. It deals with Foster superheaters and superheated steam specialties. The catalogue is in its fourth edition. The superheater consists of a series of straight tubes, generally placed parallel to each other. The straight tubes are connected by a wide elbow at one end and are joined to headers at the other. The straight elements are seamless drawn steel tubes, and on the outside they are covered with a series of cast iron annular gills or flanges placed close to each other. These are carefully fitted to the tube so as to be practically part of it. This arrangement is intended to expose a large heat absorbing surface to the hot furnace gases, and at the same time protect the drawn steel tube. The annular flanges are shrunk on the tube and thus add their quota of strength, while having heat absorbing and fire resisting qualities. The Foster superheater is simple in construction and is applicable to the stationary boilers of a railway repair shop. The Power Specialty Company will be happy to forward this interesting catalogue to any one sending in his address to them. They are at 111 Broadway, New York.

When Does Spring Begin?

A meteorological correspondent writes: When does spring begin? The almanacs are agreed that the first day of spring is the day on which the sun crosses the equator from south to north. This year that day is Thursday, March 21st, and Whitaker's Almanac, which is always precise, says in so many words: "March 21st, spring commences, 6:33 p. m." The Meteorological Office does not agree with the almanacs. It holds that the three winter months are December, January and February, and that spring began on the first of March. That date seems to be rather too early this year; for some of the most wintry weather of this year has befallen us since the first of March. The old imagination that spring began on the first of February and summer on the first of May is now quite obsolete.

An intelligent engineer who displayed no inclination to increase his store of railway or engineering knowledge once asked his superintendent what his, the engineer's, prospects were for advancement in the service. The super., a good-natured man, said: "You proceed to examine me to find out what I know about train service and the care of the locomotive." The engineer was absolutely nonplussed. He could not ask a single question worthy of attention. The super. then asked the engineer to answer some practical questions he had

seen in RAILWAY AND LOCOMOTIVE ENGINEERING and was answered satisfactorily. The engineer is now a very careful student of RAILWAY AND LOCOMOTIVE ENGINEERING and expects it will help to advance him in the near future to an official position.

CONTENTS.

INDEX TO ADVERTISEMENTS.

Railway and Locomotive Engineering

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A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXI. 114 Liberty Street, New York, May, 1908 No. 5

The Sunset Route.

It is, of course, not possible that Charles Dickens could have made any intentional reference to the railroads of the far West when he put into the mouth of Colonel Diver, speaking for the typical American, the words, "His answer to the tyrant and the despot is that his home is in the setting sun." The tyrants and despots of modern city life, the rush and bustle of business may perhaps be answered almost in the words quoted, for one of the most beautiful parts of the world is traversed by the Southern Pacific, the railway that has adopted the poetical appellation, the Sunset Route.

The Sunset Express when running over the Southern Pacific proper is between Rio Grande, Tex., and San Francisco, Cal. The distance between these two points is 1285 miles, or a little more than half the railway mileage between New Orleans and San Francisco. The run made by No. 9, the west bound train, occupies 51 hrs. and 42 mts., or an average of nearly 25 miles an hour, and the train is composed of Pullman drawing-room, sleepers, library, buffet and observation car; diner, Pullman tourist, chair cars and coaches. The road is single track and with its allied line, the Galveston, Harrisburg & San Antonio, skirts the southern borders of Texas, New Mexico, Arizona and the fruit lands and Pacific coast of California.

The word Arizona is generally supposed to be compounded of the two words, arid and zone, and refers to the dry and parched strip of land between the mountains. Outside this strip and on the coast side of the range there is one of the most fertile stretches of country in the world. This is the wonderful fruit and flower garden of southern California. The portion of the Southern Pacific which traverses this luxuriant region is called by the company the Inside Track. This bit of line extends from Los Angeles to

ON THE LINE OF THE SOUTHERN PACIFIC RAILWAY, SAN JOSE, CAL.

Redland Jct., a distance of about 63 miles, and No. 18, the Inside Track Flyer, is a train which makes the round trip from Los Angeles in the day, so that a traveler may have a very comprehensive view of the fertile San Gabriel valley.

The Inside Track was the first railway built through southern California. It passes through the sections in the highest state of cultivation. The location of the line is such that it not only reaches Covina, Pomona, Ontario, Colton, Riverside, Redlands and San Bernardino, but also touches the business section of these cities. The main line is midway in the valleys, giving the finest possible views of the mountain peaks and ridges, no intervening foothills being able to hide them from the car window.

The great warm water stream in the Pacific Ocean, which we call the Japan current, on account of its flowing along the coast of the flowery kingdom, sweeps from east to west in a majestic curve across to the coasts of Alaska, British Columbia and along the shores of California. It has its origin in the waste of tropical waters of the Pacific, that vast heating surface of the earth, as one might say. It brings warmth and moisture and makes fruitful these valleys of our western land.

There is a strange contrast between the fertile stretch of land traversed by the Inside Track and that so close at hand in the northern part of Arizona and the Great Basin of Utah. This region is practically shut off by mountains from the moist air and cloud-laden winds which blow inland from the coast, where the effects of the Japan current are felt. The region is shut off in the same way from the effects of what are practically the monsoons or rainy winds which sweep up from the Gulf of Mexico.

Writing long ago of this region, Elisée Reclus* says: "Across these vast plains, inhabited by a prodigious quantity of extraordinarily shaped lizards, the road employed by the emigrants, used to pass, which was so soon destined to be supplanted by the Pacific Railway from New York to San Francisco. Since the discovery of California thousands of men have perished in this desert, and innumerable horses and oxen have died of thirst; the right direction of the road is indeed recognized by their bones lying scattered over the ground. The traveler is obliged to stop during the night, for fear of losing his way, when he no longer hears the sound of the skeletons crushing under the feet of his steed." Whether this vision of the desolation of the desert of Colorado is overdrawn or not, the fact remains that even at the present day the traveler from the East will find the transformation from arid waste to smiling garden most abrupt and startling.

SOUTHERN PACIFIC ROAD NEAR SAN JOSE, CAL.

BRIDGE AT WATERFORD ON THE SOUTHERN PACIFIC.

That the Southern Pacific is a modern railway in the best sense of that term is shown by the steadily pursued policy of equipping it throughout with the block signal system. With perhaps a greater mileage of track protected by automatic signals than any other railroad, the Southern Pacific has correspondingly developed and improved the operation of its signal system. The company's experience is that, everything considered, the automatic system costs no more than the manual system with telephone communication. The advantage of the automatic system is that it almost entirely eliminates the danger of mistakes on the part of operators, that broken rails are often discovered before they cause accidents, and that, as operated on this road, the automatic signals increase the traffic capacity of the road.

On its single track installation, of which the Southern Pacific has completed and authorized about 4,000 miles, the standard arrangement is the placing of signals in pairs, at a sufficient distance to provide proper head-on protection. This is usually from 2,000 ft. to half-a-mile. No distant signals are used for home signals between stations, for the reason that the system was designed to meet the requirements of comparatively

*The Earth. By Elisée Reclus. Harper & Brothers, New York, 1871.

light traffic and moderate speed. At stations and sidings there are distant signals for protecting trains standing on the main line. By this arrangement the trains are enabled to meet or pass each other at stations without disregarding signals or flagging through the block.

This system was developed while the block signal installations on the company's lines were comparatively insignificant, and is now being extended along with the increase of track under automatic block. Surprise tests of enginemen are made at frequent intervals, with the result that there is very seldom any disregard of signals. The rule is that all trains must be flagged against danger signals. No permissive movements are allowed. Whenever it is found that these rules impede traffic the number of intermediate signals is increased.

When the signal installations already authorized are completed, the Southern Pacific will have 557 miles of double track, in addition to 4,035 miles of single track protected by automatic block. In addition to this there are 108 miles of track operated under the electric staff system, making a total of 4,700 miles of efficiently protected track.

Our frontispiece illustration this month shows a train on the Southern Pacific at San Jose with the block signal in the foreground. Trees are in full leaf and the beauty of the whole smiling region makes one wish to forget the smoke and noise of our Eastern cities for a glimpse of this garden of the West. Our other illustrations show the admirable block signal installations along the line. The interior of the signal tower at Oakland and the interlocking signal bridge at the same place are shown, and they form interesting examples of what may be most appropriately called the noble art of train protection as practiced on the Sunset Route.

INTERIOR OF SIGNAL TOWER AT OAKLAND, CAL., SOUTHERN PACIFIC.

SOUTHERN PACIFIC SIGNAL BRIDGE AND TOWER AT OAKLAND, CAL.

Machine Shop Reminiscences.

BILLY'S BIG JOB.

When visitors came to the machine shop Billy was the man that was selected to show them around. He loved to hear himself talk. In the presence of ladies he had the graces of a French dancing master. The visitors were of three kinds—women, children and nondescripts. The latter were generally of the fossilized barnacle class that have some mysterious attachment to the board of directors of every railroad. An air of importance dwells around these men and as long as they remain silent they pass for wise men. As soon as they begin speaking their imbecility becomes apparent. As a rule they know as much about the mechanical appliances used on railways as they know about the rings of Saturn. Sometimes their minds are strangely mercurial, running into forgotten channels and blossoming into fearful and wonderful inventions. A genius of this kind came along one day with a bundle of drawings and a letter from the president of the road. He was going to increase the heating surface in locomotives. He was going to save coal He was going to burn smoke. He was going to make a noise in the mechanical world.

He made a noise but, as usual, it was the unexpected that happened. Of course his invention was patented. The same thing had been patented a dozen times before. Since the days of "Puffing Billy" down to the present time a series of wise men have followed each other in unbroken succession and racked their brains or their book shelves on the same problem and evolved the same old devices in the fire box. Sometimes it is arched longitudinally, sometimes concaved transversely. Again it is built in with the boiler, a slanting encumbrance running from over the fire-box door and merging into the throat of the boiler under the flues. Of course the shelf has a hole in it where a small man can with difficulty squeeze his head and shoulders through and make an ineffectual attempt to clean out the lower flues that become choked in a few hours. Costly and cumbrous, and thrown aside

ON LINE SOUTHERN PACIFIC.

a hundred times, there is the germ of perpetual youth about it. Like Banquo's ghost, it will not down. Of course these gifted inventors have no knowledge that the same thing has been invented and patented before. If they do, they act as if supremely unconscious of each other. They have the nerve to pretend that they never heard of such a thing before and nobody has the nerve to contradict them. Like the assassins of Julius Cæsar, "they are all honorable men."

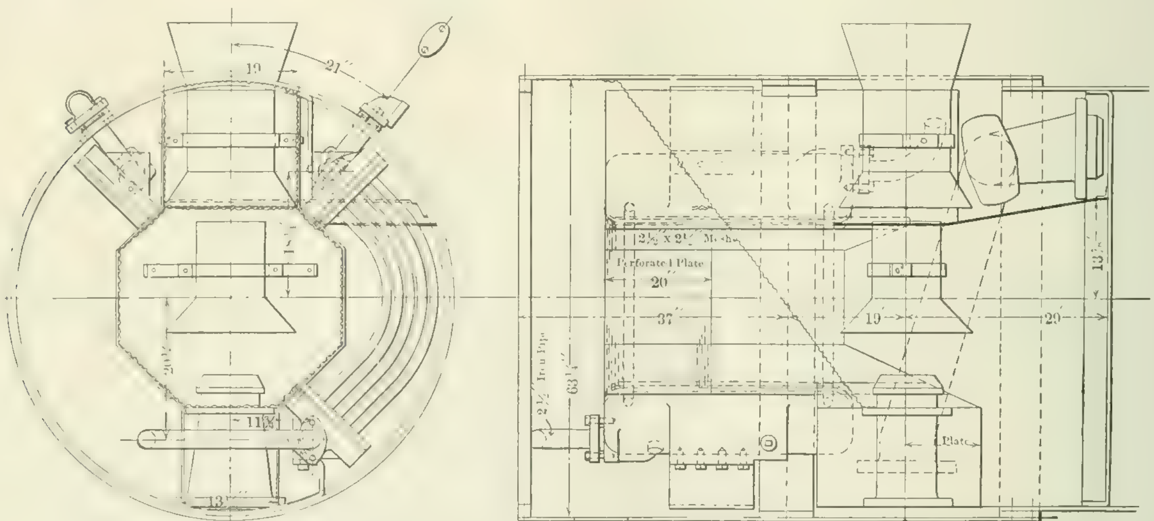
This was the kind of man and the kind of invention that invaded the shop, and Billy and two helpers were put on the job. Billy began at once wearing white collars. In a machine shop this is a sure sign of promotion or of a swelling of the head. Billy had both. A fire box job does not require collars, but dignity must be maintained. In addition to wearing collars Billy also wore an air of mystery. Like a star, he dwelt apart. He had a pit at the far end of the shop where the old "49" sat on blocks like patience on a monument. What with drawings and templets and castings ponderous as tombstones, any one could see from afar off that something unusual was going to happen.

The inventor came in every day at ten in the forenoon, and without looking to the right or to the left walked straight to where Billy was busy on the big job. The two talked incessantly until it was nearly time for Billy's cat to make its mid-day march, preparatory to the grand stampede for Clark's parlors. The big job progressed slowly, as do all great undertakings. Meanwhile the superintendent of motive power groaned in spirit. The conversations between him and the chief clerk would make interesting reading, but much of the language would be unfit for publication. The gist of it was that at a time when they were short of hands, ordered to reduce expenses and short of engines, an absurdity like this had to take away three of his best men, not speaking of the use of tools, and, of course, when this was done some other preposterous proposition would have to be attended to. A dark cloud of maddening misery gathered around him every time he glanced at Billy's big job.

The job was no easy matter. There were two great castings set slantwise in the fire box. They touched each other in the centre, but intercostal spaces intervened between them and the sides of the fire box. Short pipes were screwed into the castings and brass sleeves threaded upon the pipes screwed into the fire box sheets. A row of brass inspection plugs ran around the boiler, closing up the openings where the connecting pipes could be inserted or withdrawn. The difficulty in getting these numerous attachments all tight under pressure was increased by the ponderous weight of the hollow castings that had no other support than the threaded pipes. Over the central aperture formed in the castings was hung another attachment suspended from the crown sheet like a Belfast ham in a Dutch grocery store. This also increased the water space and heating surface, and being directly in the line of the fire it was something of which great things were expected.

At last Billy's big job was done. The engine was steamed up and out in the yard a fire was kindled under the new invention and Billy and his satellites were busy. The inventor, of course, was on the spot, a gleam of triumph in his proud eye, and a gold headed umbrella in his gloved hand. Billy was up on a plank laid across the hand rails setting the safety valves. Old Pete, the engineer, was calling out the figures recorded by the trembling pointer on the steam gauge. "One hundred and thirty-five—one hundred and"—bang—!!!—one hundred and forty cannon fired at once from a British "Dreadnought" could not have surpassed the appalling crash that shook heaven and earth and the waters under the earth. The old 49 fairly danced in the startled air like a colt throwing up its hind legs on a May morning. Sheets of white fire flew out at the ash pan lids. Old Pete went over the back of the tank with a velocity altogether beyond a man of his years. Billy's helpers ran like a pair of college athletes in a regimental relay race. In a cloud of boiling water and scalding steam the inventor rushed blindly anywhere out of the terrible tempest, and fell headlong in an ash pit that was cleaned out every Wednesday. In the adjoining streets women shrieked and clutched their helpless babes to their bosoms. Strong men stood still. Out of a signal box a face looked that had never been known to look out before. It was the signal man, who seemed inclined to venture into the open air, but evidently changed his mind and shrank back into his hole again, like a rabbit that has been disturbed by an earthquake.

Where was Billy? Standing like a statue wreathed in fire and smoke, his arms folded like a commander in battle. His feet never moved from his lofty platform. He majestically met the occasion. The center of the terrible tornado, the apex of the awful avalanche, he surveyed the maddening maelstrom in an attitude of colossal calm. When the wilderness of waters had subsided and the darkened air had become translucent, Billy stepped down from his lofty perch and received the congratulations of the assembled multitude on the conclusion of his big job.—*Finis Coronat Opus.*



ARRANGEMENT OF FRONT END APPARATUS—LOCOMOTIVE FEED WATER HEATER.

The General Electric Company has secured a very large order from the Chicago Railway Company. It is said to amount to about one million dollars and is for 400 four-motor car equipments. An order has also been received from the Companquia Pocas de Santos, Brazil, for a complete sub-station equipment. Smaller orders have been received from the Manchurian Railway, Corea, and the Sao Paulo Light and Power Company of Brazil.

Central of Georgia 2-8-0.

Our illustration of a consolidation engine on the Central of Georgia Railroad is interesting as the engine is equipped with a feed water heater. The engine was built at the Baldwin Locomotive Works and is simple, with cylinders 20x28 ins., 56-in. drivers and 200 lbs. boiler pressure. This gives a tractive effort of about 34,000 lbs.. and the ratio of adhesion, with weight on drivers 150,500 lbs., is 4.4. The driving wheel base of the engine is 16 ft. The valves are ordinary balanced slide, driven by Walschaerts gear.

CONSOLIDATION WITH FEED WATER HEATER ON THE CENTRAL OF GEORGIA RAILWAY.
F. G. Gaines, Superintendent of Motive Power. Baldwin Locomotive Works, Builders.

The feed water heater, which is the feature of the engine, is briefly a series of pipes in the smoke box and under the running board which are warmed by what would otherwise be waste heat, and that economy must be the result is obvious. An approximate saving of 20 per cent. is said to have been obtained with such a feed water heater, by the locomotive superintendent of the Egyptian State Railways, Mr. F. H. Trevithick.

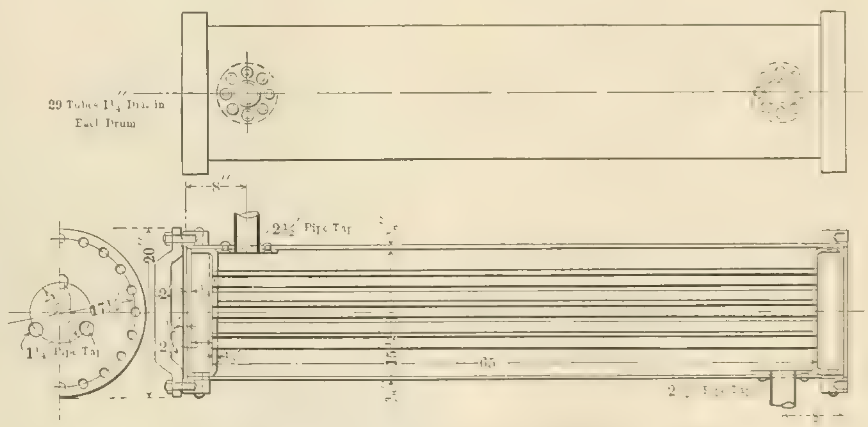
The feed water heater as applied to the consolidation here illustrated consists of a duplex horizontal pump placed on the running board and delivering water drawn from the tank to two drums, one on each side of the engine, secured under the running board. The one on the left side being between the air pump and the feed water pump. These drums are filled with small tubes, through which the air pump exhaust steam is made to pass. Exhaust steam from the water pump also passes through the tubes in these drums. The tubes carrying the exhaust steam from the pumps are surrounded by feed water which is being slowly urged through the drums, and in this process it abstracts heat from the tubes carrying the exhaust steam. In order to augment the heat in the drums, a small quantity of steam from the exhaust passages of the cylinder is also introduced.

The feed water, having made the journey through the drums and their connecting pipes, passes into a series of pipes in the smoke box somewhat similar to a Baldwin superheater. After passing through the smoke-box heater the feed water, now quite hot, enters the boiler through a check valve placed in the usual position on the left side. One of our line cuts shows the general construction of the running-board drums and another gives a view of the smoke-box arrangement. The distance traversed by the feed water in the smoke-box tubes amounts to about 25 ft. and the heat from the waste gases of combustion is absorbed by the water as it passes through the tubes. Deflector plates are arranged in the smoke-box so as to compel the hot gases to completely surround the heater pipes.

The water is forced by the feed pump through the several heaters of the system at a comparatively slow velocity, about 16 ft. a minute, which is considerably slower than the rate of water delivered direct by an injector through the ordinary short delivery pipe. It is estimated that water thus heated on its way to the boiler is raised to something like 300 degs. F. Water and steam at 200 lbs. boiler pressure has a temp. of 387½ degs. F.

This feed water heater, as used by Mr. F. F. Gaines, S. M. P. of the Central of Georgia Railroad, is supplied with water containing very little incrusting matter, and none of the heaters are ever sufficiently hot to bake the scale which does form. The heaters are arranged so that they can be washed out in the usual way.

The boiler of this engine is of the extension wagon type, with a diameter at the smoke-box end of 61 ins. The tubes number 283, each is 2 ins. in diameter and 14 ft. 8 ins. long. The tube heating surface is 2,161 sq. ft., the fire-box surface is 146, thus giving a total heating surface of 2,307 sq. ft. The grate area is 44 sq. ft. and the ratio of grate to heating surface is therefore as 1 is to 52.



DETAILS OF HEATERS UNDER THE RUNNING BOARDS.

The tender is carried on structural steel frames and the tank holds 6,000 gallons and carries 8 tons of coal. Some of the dimensions of this engine are as follows:

Weight in working order	168,2[illegible] lbs.
Weight on drivers	150,5[illegible] lbs.
Weight on leading truck	17,[illegible] lbs.
Weight of engine and tender	288,[illegible] lbs.
Driving journals	[illegible] ins.
Firebox	[illegible] ins.
Water space	[illegible] ins.

The Coning of Car Wheels.

Last month we gave on page 143 a brief resumé of the first part of a recent address given by Mr. S. P. Bush to the members of the Western Railway Club on the subject of "The Car Wheel and Its Relation to the Rail and Car." In the earlier portion of his remarks the breaking of wheel flanges was discussed. Coming to the "coning of car wheels" the speaker said that the consensus of opinion seems to be that coning the tread of car wheels had rendered some assistance in making wheels in service track better on tangents, but that the increased coning served to concentrate the load on a small area.

Little attention has been given to the matter of distributing the load, or to so applying brake shoes as not to heat the wheel flange. Brake shoes are often hung so as to wear into the throat of the flange. When a new wheel is put in service on new or old rails the bearing between wheel and rail shows more or less concentration of load. As wear takes place, which must be very rapid with the small bearing, the area of contact increases until finally the coning is all worn off except a small portion near the flange, but the tread in time increases its bearing, so that 1½ or 2 ins. or sometimes more

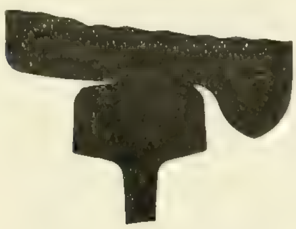


FIG. 4. WIDE BEARING.

of the width of the tread comes in contact with the rail.

Apparently this is a condition to which it is desired that the wheel should come. If wheels are successful in reaching this condition they are likely to continue in service for their normal life. It would appear that the portion of the coning that remains may be at times reasonably effective in preventing the flange from running to the rail.

It is difficult, if not impossible, to mount a large number of wheels, and to have each two on the same axle of exactly the same diameter. Coning has for its principal object the equalization of the differences in diameter. The wheel of smaller diameter will have a tendency to run to the flange and the wheel of larger diameter will have a tendency to run away from the flange. In time they seek a level, and so accomplish the result desired.

Mr. Bush believes that having reached this working basis of wear, coned wheels are then in far better condition to stand service successfully than they were when first put into service, because the load has gradually changed from a concentrated condition on a small area near the flange to a more distributed condition on larger area extending toward the edge of the tread. If the working basis attained by wheels after a certain amount of service be good, why should not this condition be secured when wheels are first put into service by making the contour accordingly?

The speaker proposed a form of wheel tread derived from a composite contour which corresponds closely to that shown in Figs. 4, 5, 6 and 7. A contour that contains a coning beyond

FIG. 5. NARROW BEARING.

the fillet having some relation to the top edge of the rail, so as to avoid extreme concentration of load, but which permits the wheel to roll for a short time on a large diameter, would be, he believed, a more effective means of protecting the flange than that at present provided. This contour, Mr. Bush said, bears a better relation to the rail,

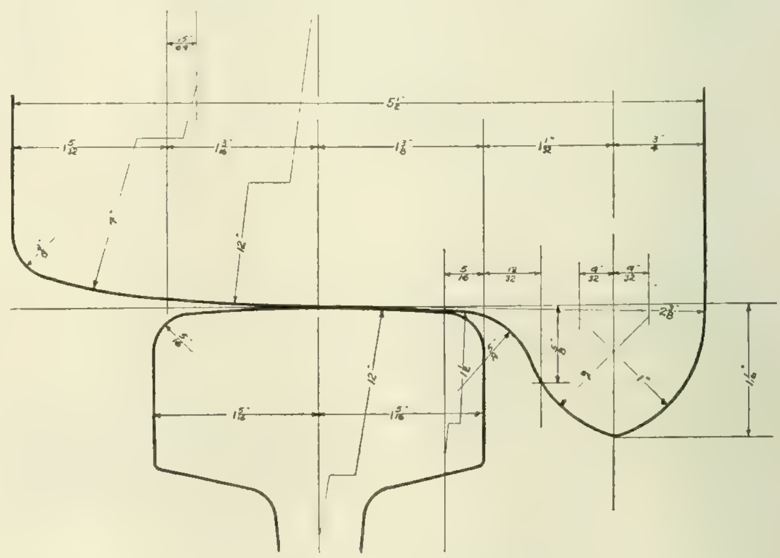


FIG. 7. CONTOUR LINES OF RAIL AND TREAD.

is quite as effective in equalizing the differences in diameter, has the material advantage of distributing the load between rail and wheel tread, and makes the wheel more serviceable with less opportunity for failure than would the straight coning of 1 in 20 or 1 in 25 recently recommended and now constituting the practice of the country.

The speaker disclaimed any belief that this form of tread contour which he suggested would alone remove existing difficulties, but he considered it reasonable to believe that such a tread

FIG. 6. APPROXIMATE OUTLINE.

would tend to somewhat mitigate the difficulties if, as it seemed to him, desirable to distribute loads on the tread of the wheel rather than to concentrate them.

It may here be said that a glance at Fig. 7 shows the form of tread which Mr. Bush favors. The rail is shown with a crown curved to a radius of 12 ins., and the proposed wheel tread practically follows the rail contour from a point 5/16 in. inside the rail edge to the centre of the wheel, and from the centre line of wheel and rail the tread curves upward on with a 12-in. radius and that the outer portion follows a 4-in. radius until the edge of the tread is made by a ⅜-in. radius.

Rolling stock belonging to the Intercolonial Railway has heretofore been marked I. C. R. This is said to cause a certain amount of confusion with similarly marked cars on the Illinois Central Railroad, and it is announced that the Canadian road will in future alter the sequence of the designating initials to I. R. C., which stands for Intercolonial Railway of Canada. The confusion was in freight car accounting. Initials are used in reporting the movements of cars and the change is now being made by the Canadian road as rapidly as possible.

General Correspondence

Old Time Experiences on the B. & Z.

Editor:

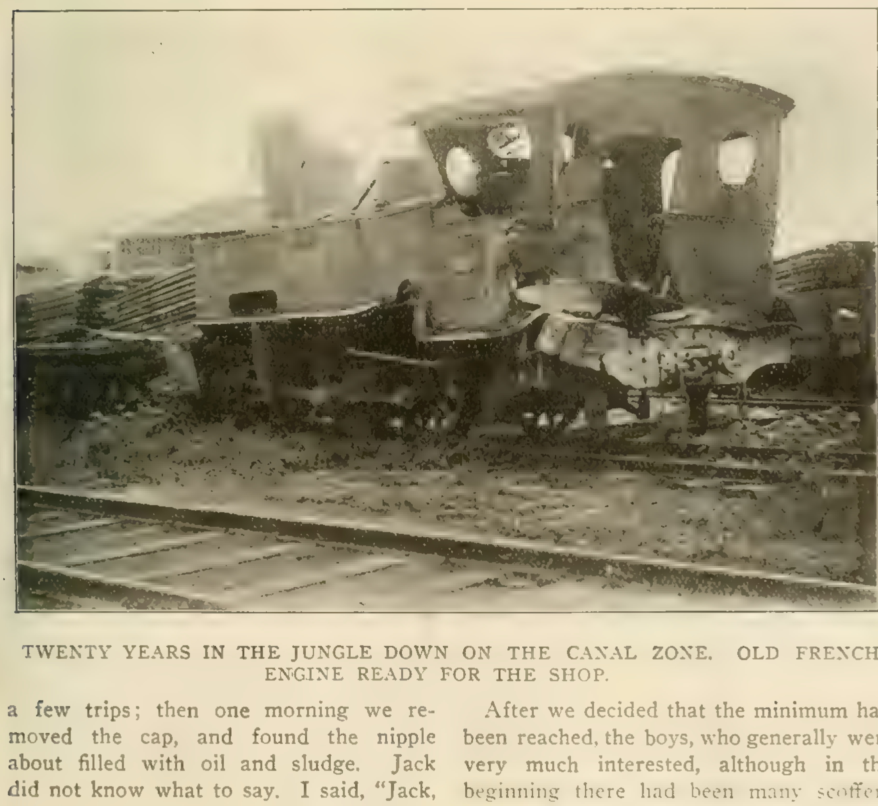
Up to December, 1884, our reports of cut air cylinders, gummed and broken valves, broken packing, etc., had increased steadily. The "Old Man" said something had to be done. I spent some time trying to convince the engineers that they were using more oil in the air pumps than was necessary, and that the habit they had of letting the oil draw up through the strainer did no good, but was an injury. They seemed to think the more oil they could use the better. I argued with them for a while, but the best we could do was to get them to cut down the lubricator feed on the steam end, so we got fairly good results therefrom.

After a lot of "cussin'" and discussion, I thought of a scheme, and got Jack Wotrab to give it a fair trial. The morning after Christmas he took out the 91 with a new contraption on the air pipe leading to main reservoir. We had put a tee in the air pipe close to the pump, in the outlet of the tee we put a nipple 12 ins. long, with a cap on the bottom.

Jack promised to cut down the supply of oil as much as he thought safe, and feed it through the small cup on top, and give the strainer the go-by. He made a few trips; then one morning we removed the cap, and found the nipple about filled with oil and sludge. Jack did not know what to say. I said, "Jack, where would that have gone if the nipple had not caught it?" "Into the main reservoir," he replied. "Don't you think we could reduce the amount quite a lot and have plenty yet?" "Yes," said Jack, "and I am with you now, and will keep at it until I know just how much oil will keep the pump in good working condition."

ON THE CANAL ZONE. OLD FRENCH ENGINE AFTER A THOROUGH OVERHAULING IN THE SHOP.

After we decided that the minimum had been reached, the boys, who generally were very much interested, although in the beginning there had been many scoffers and doubters, began to be convinced that there was something in the idea after all, and soon fell in line. Needless to say, reports of hot air cylinders, broken and gummed air valves, etc., decreased very much, and it was only a short time before our sheets began to show a big cut in repairs to air pumps as well as a much better oil report.



TWENTY YEARS IN THE JUNGLE DOWN ON THE CANAL ZONE. OLD FRENCH ENGINE READY FOR THE SHOP.

We had ten-wheel engines in use on our milk trains, and the main reservoirs on them were placed between the frames back of the cylinders. These were difficult to get at to drain, unless over a pit. As we had no pit at the north end, where the crews laid over, the engineers were instructed to have the reservoirs drained at the south end of the road.

They were due there about midnight, and we found that the engineers were paying very little attention to the draining of the main reservoirs, on account of the time the engine was held at the ash pit, having the fire cleaned and coaling up, which was done by hand. They had to leave about four in the morning, so the engineers put in all the time they could sleeping, after coming in and turning the engines over to the hostler.

In cold weather we had complaints come in that brakes were giving considerable trouble owing to the triples freezing, which led to a great deal of annoyance as well as expense, and for a while, just after the engineers had been called to account, they would pay some attention to draining the reservoirs, yet in a short time the same old complaints would again come in.

Many of the milk cars were left at

way stations on the up trip to have the empty cans removed and the full cans put in ready for the down trip. Very often it was necessary to send one of the inspectors a long distance to thaw out triple valves. This became intolerable. Finally, I devised an automatic relief valve, arranged to remain closed until the pressure decreased to a certain limit, and then to open automatically, draining the reservoir. Thus, when laying over, as soon as the air line pressure dropped, say to about 2 lbs., the valve would open and the system would be drained. After a few trials in getting the spring adjusted so that the valve would open at the defined pressure, we removed the plugs and put in the automatic valves. The trouble at once ceased, no more water was left in the reservoirs to be forced along to the triples, and consequently no more time was spent in thawing out. More air volume and better brake service resulted, and the engineers all began to have the new valves put in.

An incident that occurred on the next engine that was equipped with the de-

DIAMOND STACK AND EXTENSION FRONT.

vice came pretty near hoodooing it, for one man at least. After the engine had made the run of sixty-five miles to the lay-over terminal, the engineer told the fireman that after they had lunch he wanted to pack the back engine truck boxes. He shut off the air pump and after he had lunch came back to pack the boxes, and as he approached the engine he heard a sound, and saw the fireman coming out from under the engine in a great hurry covered with black oil all over his neck and back, and swearing like a pirate.

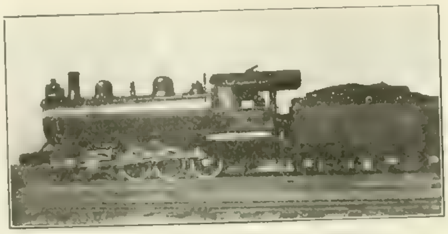
It happened that the fireman thought he would pack the boxes himself, and as the air was shut off, the pressure began to go down, and as he was just nicely getting to work, the pressure reduced enough to allow the valve to open and the remaining pressure was enough to force the oil and sludge over him. He expressed himself very forcibly about "d——d patents," and swore by the great horn spoon that the next time he went to pack boxes he would know that the air pump was running. W. C. E.

Passaic, N. J.

Railroading in Colorado.

Editor:

Every year thousands of people visit "the Switzerland of America" and every one of them comes back with wonderful stories of the grand and beautiful scenery,



SHORT LINE 2-8-0.

healthful climate and pure air to be found there, but few ever tell you anything about the railroads there. Well, I went to Colorado in September, just when the heat and dust of the city begins to tell on one, and I was duly impressed with all the things I have mentioned and with the railroads, too.

I took the Burlington from Chicago, and arrived in Denver the morning of the second day. The first thing I noticed was the Union Station. It hasn't any train shed, but it is a good building, and as the weather seemed very dry perhaps they don't need one. The first thing that strikes the eye of the engineer as peculiar are the tracks—they are all laid with three rails. You see, a lot of the roads out there are of three-foot gauge, and all the through lines are of standard width. In order to accommodate both and save expense three rails are used, the two outside ones being 4 ft. 8½ ins. apart, and one outside and the middle one 3 ft. apart. The switches and crossings look pretty complicated, but I suppose they aren't when you get down to it.

The Burlington, Union Pacific, Colorado & Southern, the Denver & Rio Grande and the Colorado Midland come into this station and it's a busy spot.

The Burlington still has some engines with the good old diamond stack. They

NO. 23. F. & C. C. RY.

burn lignite coal, I think, and seem to work O. K. A picture of C., B. & Q. 6 wheel switcher, No. 1369, is given here, and it will be seen that she has an extension front, too.

The C. & S. have both standard and narrow gauge equipment, and I spent an interesting morning in their roundhouse. The pits all have three rails and so does the turntable, and you've no idea how funny a little narrow gauge mogul looks beside a big consolidation. The road uses some consolidation engines of three-foot gauge and they look all wheels and rods. How they ever get at the link motion I don't know. Here would be a good chance to use the Walschaerts valve gear, I should think. The main reservoirs are placed on top of the boiler or back of the tank and a good big air pump is provided on account of the grades. The passenger trains are hauled by little moguls and the cars look very comfortable, indeed.

The rolling stock of the other roads isn't unusual in any way except that you see a lot of Vauclain compounds on the U. P. Some of them have tail rods and they seem to work very well.

I then took a short excursion on the Denver, Northwestern & Pacific, a new road being pushed towards Salt Lake City. It is supposed to cross the Rockies on an easier grade than any other system,

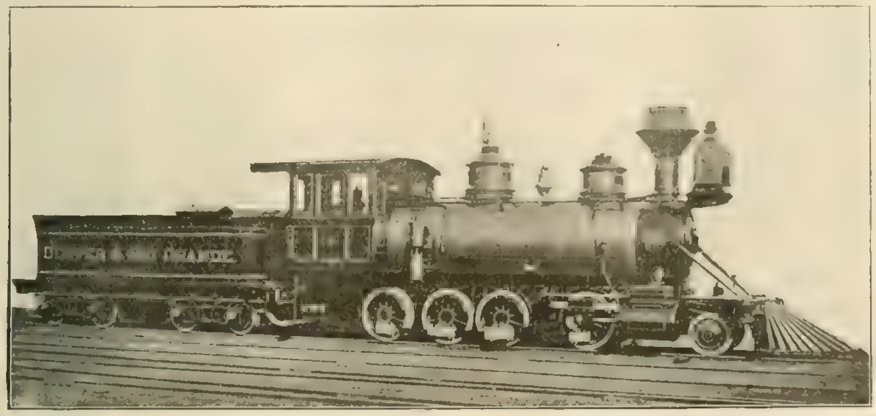
NARROW GAUGE 2-8-0. ENGINE ON THE C. & S. RY.

but it looked pretty stiff to me and it seems about all one consolidation locomotive could do to haul our light excursion train. The motive power consists of 10-wheelers, consolidations and 6-wheel switchers, all built by the American Locomotive Co. The consolidations have two 9½-inch air pumps and they make an odd noise when working, as they exhaust unevenly, as though the valves were set wrong.

The road abounds with snow sheds and has the distinction of owning the largest rotary snow plow in the world. I guess they need it, all right, for the road crosses the Continental Divide, and there is plenty of the beautiful there even in summer. Leaving Denver, I took the D. & R. G. to Colorado Springs. The most interesting road around here is the Manitou & Pike's Peak Ry., known as "the cog-wheel route." It has been written up so many times I won't describe it here, but it is a mighty fine little road, and the engines are beauties. If you ride up on this road and shut your eyes you will think you are on the engine of a B. & O. freight train going through the Sand Patch tunnel, they puff so loud.

From Colorado Springs it is a beauti-

ful ride to Cripple Creek, the centre of the gold fields. You take the Colorado Springs Cripple Creek District Railway, and this carries you through the wonderful North Cheyenne Canyon to Cripple Creek. The road is splendidly built and climbs the Rockies on a six per cent. grade. The trains are hauled by fine consolidation locomotives, as shown. The scenery is more beautiful and less rugged than on the D., N.-W. & P., and on the whole I enjoyed it more. The car, too, had an observation end, and this may have added to the pleasure of the trip.



DENVER & RIO GRANDE 2-8-0 ENGINE.

At Cripple Creek the narrow gauge roads are in full swing and you see rows and rows of funny little box cars that look as if someone had sat on them. The couplers all seem too big for the cars, and they have too much overhang.

The Florence & Cripple Creek Railroad runs in here and it uses about the finest narrow gauge locomotives I ever saw. I enclose two pictures of No. 23 on this line, and, as you can see, she is mighty well proportioned. The motive power is kept up in the best possible shape and the road is much better equipped than lots of standard gauge ones. "23" was built by the Schenectady works of the American Locomotive Co.

The place to see the real narrow gauge road as it used to be is Salida, on the Denver & Rio Grande. This road used to be all three-foot gauge once, but some of it has since been changed. It still uses its famous line over Marshall Pass, however, and has lots of narrow gauge engines. They are older than the others I have mentioned, and were mostly built by the Baldwin Locomotive Works. Diamond stacks are still in use and they looked good to me, for I used to swear by them. The D. & R. G. was the original road in Colorado and at one time it seemed as though it might form a long link in a trans-continental line of three-foot gauge. Traffic interchange prevented this, however. I give pictures of some narrow gauge engines of this line. They are standard types as used on "the Scenic Line."

I have exhausted my paper and had better stop, but there is more still that might be said about railroading in one of the most wonderful States of the Union. HUGH G. BOUTELL.

Urbana, Ill.

The Steam Locomotive.

Editor:

I should like to see if we cannot get some discussion started on the steam locomotive in your valuable magazine. Railroads seem to be staggering under the heavy expense of fuel. I see very little difference in the construction of the present locomotive over that built twenty-five years ago, particularly as regards the principle which is involved in locomotive engineering. To my mind the locomotive is almost as crude as the first steam engine used by Watt. The locomotive uses water sometimes as cold as 33 deg., and has to raise it to 387 deg., many times as high as a gallon a second. That being the case, is it any wonder that the flues, stay bolts and mud-ring frequently leak? The mud-ring is exposed to zero air and in the fire box to 3,500 deg. of heat, which soon ruins the side sheets. Still we go on in the same old way, wasting millions for fuel and repairs.

The Stephenson valve gear has been used many years and seldom gives any trouble. After years of idleness in this country the foreign Walschaerts gear is taken up. Some one began the use of it and now all or most all the superintendents of locomotive power are following. Soon after this comes the superheater, and that is taken up and tried; still the fire box, mud-ring and flues are suffering. Cold air enough is taken up through the grates with such force as to carry it through the flues, and we frequently have a fire in both ends of the boiler. Nothing has been done to remedy these troubles.

Some roads are trying gasoline and electricity, yet here we are with millions invested in the steam locomotive and continuously building on the same old plans, all because we have not devoted sufficient time and toil to the improvement of the steam locomotive. There never has been but one man's name mentioned in your magazine who has offered a solution for the troubles mentioned above, and then he received little or no encouragement. With fire boxes too large for any fireman to keep the cold air from, a draught sufficient to pull holes through the fire, and nozzles the same size the year around, coal almost all sizes down to dust, and no chance to change the draught in the different cut-off engine, burning all the coal on grates, which means waste of millions of heat units.

We should no more think of using cold water for the boiler than try to burn wet wood or green wood in the fire boxes. Yet when any man takes up the question of fuel economy they open their eyes, but when they are told the present system must be changed, not a cent will they spend towards the suggested improvement, but will fritter away money in coal, which means a heavy running expense.

STANDARD 4-4-0 TYPE ON THE D. & R. G.

The idea of running a machine until it is ready to fall to pieces and then sending it hundreds of miles to the shops to be returned with so many things left undone that should have been done is a costly and mistaken idea. There was a time when men were glad to get a machine back from the shops, but not so now.

Engineers lose their pride in their machines. There is nothing but ruin in

sight. It is not like the teamster who has a good team of horses and does all in his power to keep them in good condition. In fact the locomotive will run as it is now built, but, cost what it may, is costing the railroads extra millions for fuel and repairs each year. After an experience of twenty-five years as fireman and engineer I see no reason why the present locomotive cannot be made more efficient than any other steam machinery in the world. The very elements now contended against can be made to serve to great advantage. The steam draught is too expensive; it throws away millions of dollars spent for heating water. The by-products of many concerns have made them rich. The fine coal now thrown out through the stack is a complete waste and the amount so wasted is enormous. Steam should produce the draught, but this same steam should return to water again, not only to reduce the number of water tanks along the road but to save hauling so much water and coal. When a locomotive raises water 35 deg. to 387 deg., instantly somebody is spending recklessly for fuel and repairs. The steam locomotive is the most powerful means of transportation in the world. Large cities object to the locomotive because it emits so much smoke, but this is the natural result owing to the consumption of so much coal, and under the present method of locomotion consequently cannot be avoided.

I take exception also to the wide, shallow fire boxes for bituminous coal, and my claim is that the deep fire boxes burn the smoke and gases to better advantage. It is not always the amount of coal used, but how it is placed on the grates. The fireman can fire all day on a "too thin" fire and not keep a full head of steam; holes in the fire of varying sizes will beat any fireman.

The firemen of to-day are receiving poor training in their line of work owing to the fact that they have no regular engineer to work with. No one takes any particular interest in him, and as a result many times his work is done in a haphazard and slovenly way. Many old engineers are failing to keep up their former standard because of poor firemen. An engine that is rushed beyond its medium will be expensive from the fuel standpoint and will soon need repair. I can say much more along this line if you see fit to publish this communication. Perhaps it may set some general manager or superintendent of motive power thinking and I hope to start some discussion.

W. E. Wiley,
Locomotive Engineer.

Sioux City, Iowa.

[In this issue we give particulars of a feedwater heater, also of the Allfree cylinder and valve, also of the Brotan boiler. Discussion on the steam locomotive is in order.—Ed.]

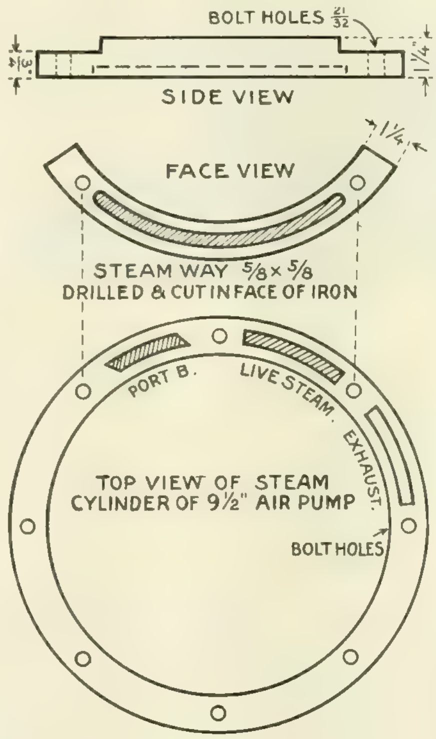
Handy Testing Device.

Editor:

I send you a sketch of a device for forcing the main piston of a 9½-in. air pump to the top end of its stroke after the top head has been removed.

It consists of a piece of 1¼-in. iron, bent to conform to the curve of the end of the steam cylinder. There is a port or steam way drilled in its face, to conduct steam from the steam port to the port leading to the lower end of the steam cylinder. It can be bolted in its place with two of the top head bolts and the top head gasket used to form a joint.

This can be used to test the steam piston packing rings for leakage, to raise the steam piston when the reversing plate is torn off, especially if the



TESTING DEVICE FOR AIR PUMPS.

pump is above the running board and very near to it, to pull the piston up if it is stuck fast to the lower cylinder head, or it may be used to loosen the air piston on the rod.

G. W. Kiehm.

Washington, D. C.

Derailment of Tenders.

Editor:

On a certain road running out of Chicago they have had an average of one tank derailment a month on their passenger engines while going at a good rate of speed, safety chains preventing a serious accident in most cases. If the defect was in the track, which is far from being perfect, the same sort of accident should happen to the engine or coach, but it is always the tank. These are all of practically the same design, and in service for last ten years, kept in good condition, on same runs. They never caused trouble until about one year ago.

The tanks hold about 4,000 gallons of water, 10 tons of coal; are of average height, with a double pair trucks, with wooden bolsters; about ½-in. play on side bearings; with good flat double springs in front and back trucks on sides. Outside are Monarch brake beams on brake hangers connected to sill of tank with a hinge or strap on top end of hangers. Sometimes it is No. 1 pair that is derailed, while again it may be Nos. 2, 3 or 4 wheels.

Derailment may occur at a curve and the next time on straight track going at high rate of speed, or again at 15 miles per hour. First the officials placed cause to rough track, then water splashing from one side to the other; next drawbar between engine and tank too close to front tank sill; next too much weight on side bearings. Then tank truck did not tram, one wheel running ahead of the opposite wheel; next blame was put on the safety chains being longer on one side than on the other. Finally they concluded that the centre castings were not in proper position.

All of these imaginary defects were altered with the same result. In fact the tank that looked in best condition often caused the most trouble. Cast wheels 33-ins. diameter are used and removed for the slightest defect. This continual round of pleasure has been hashed over so often among the different department heads without their agreeing upon or adopting a remedy that no doubt some reader of your valuable paper who may have had some similar experience can enlighten us all.

C. B. M.

Chicago, Ill.

[In the general correspondence columns in the April issue of Railway and Locomotive Engineering (page 149) we published a letter from Mr. W. S. Gray, the general foreman of the Louisville & Nashville Railway, at Covington, Ky. In this letter, which was headed "Defects of Steel Tires," Mr. Gray referred to the more or less frequent derailment of tenders which have taken place within recent years. Any of our readers who can throw light on this matter will find the columns of our paper open to the discussion of this important subject. The fact is there. What is the cause?—Ed.]

Improved Air Brake.

Editor:

In the March number of your magazine there is a description of my automatic brake, patent No. 875,543. In the

latter part of the article you refer to it as being used in case the air brakes fail to work. Permit me to state that this invention is an automatic brake within itself, and it is not necessary to have any other brake.

This brake will work on a car in a train equipped with other automatic air brakes in perfect harmony, as a reduction of air in the train line sets my brake the same as any other automatic brake. It should be understood that there are no valves in connection with this brake, except brake valve on the engine, as the brake is set by spring pressure and held unapplied by air pressure.

JAMES LYNCH.
Van Buren, Ark.

Brake Valve Ports Corked.

Editor:

The suggestion of Mr. G. C. McDougal of the Atlantic Coast Line Railway in regard to the discussion of the diseases and remedies, also how to detect the troubles in the E. T. Equipment, meets with the approval of the writer. It is for the benefit of those handling and repairing this equipment.

A few days ago we received a report on one of our new engines as follows: "Engine and tender brake do not fully release except with the use of the independent valve in full release position."

In testing the brake there was not the natural exhaust when releasing. I disconnected the pipe leading from independent to automatic valve, tried brake and its exhaust was O. K. Next the automatic valve came in for examination. I found in rotary seat, release port C, a piece of cork where port makes a turn. To extract it was impossible, so it had to be blown out with air. I can find no explanation of its appearance there except it be the carelessness of the workman in not extracting the cork when placing valve on engine. All valves are corked when shipped from factory to prevent dirt entering ports.

A second case of the same nature as the one just mentioned was as follows: "Independent valve refuses to set brake." Upon examination I found a piece of cork lodged in port A of reducing valve, preventing air from entering the application chamber. Here is another: "Brake will not release and there is a continuous blow at the brake valve exhaust."

The cause was located by closing the cut-out cock at the main reservoir; disconnected union on the application cylinder pipe, cut in air to note which side air came from (brake valve or application chamber). Air came from latter. I then closed the cut-out cock and disconnected the distributing valve from the chamber. Found gasket blown out from main reservoir port to the application chamber, air entering same faster than release pipe would exhaust it, thus keeping brakes applied.

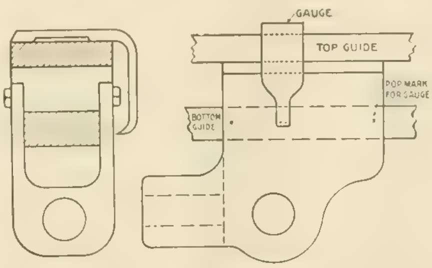
Hoping these few items will be of interest to the readers of RAILWAY AND LOCOMOTIVE ENGINEERING.

M. A. SCHUSTER.,
A B Dept., C. & N.-W.
Milwaukee, Wis.

Cross-Head Gauge.

Editor:

We have found it good practice when guides are correctly lined up to put a gauge on the top guide and scribe a line at each end of the cross-head and mark the line with a centre punch. It is immaterial whether the top or bottom guides or gibbs wear the most. It will be found after a few months' wear that when the gauge is applied there is a considerable variation in the exact position of the cross-head. When the top guide is oval shaped, as it is in many engines of this class, it will be found that the guide is



GAUGE USED IN LINING GUIDES.

flat at the extreme ends, where the gauge can be advantageously used. A careful use of a gauge of this kind will not only show exactly how much the guides should be closed, but where babbitting may be advantageously done. The gauge will also show if the piston rod has been sprung, as is often the case when too much lost motion is allowed to accumulate in the action of the cross-head in the guides. We have had guides closed and rebabbitted several times on the same locomotive and found by careful experiment that the gauge was to be depended upon.

A. J. MONFEE, M. M.
B. S. Ry. Shops, Pratt City, Ala.

Broke in Two and Didn't Know It.

Editor:

My first experience with your interesting magazine was in 1895. My age was six and a half, and my interest in engines as large as myself. So when my father, an engineer on the Pennsylvania, came home one day with "January, 1895," under his arm, it was a second Christmas for me. I can remember still the snow plow on the cover, the English engines on the first page, etc., but I can remember still better a sad little boy, a broken pancake turner and a very red spot about two inches square on the rear portion of said little boy's body when, a couple of days later, he was found extracting the engines from his father's paper by means of a pair of scissors, with the evident intent of having a paper railway all his own. Needless to say we have taken RAILWAY AND LOCOMOTIVE ENGINEERING ever since, and it now takes a good sized box to hold the thirteen volumes. Now that I am a fireman of two years' experience, "my books" come in exceedingly handy when I get curious. But to talk about myself was not my intention at all when I started this letter.

I have read several articles lately concerning breaks-in-two where the hose on the head portion of the train kinked so as to effectually hold the air in the brake pipe, thus preventing an application on the head part. The magazines in which these were published seemed to discredit them, as did several engineers and firemen with whom I have talked. I was very much pleased to be on a train, a short time ago, upon which this very thing happened. I am on the Youngstown branch of the Lake Shore and about half way between Youngstown and Ashtabula is a telegraph office and side track, designated on the time card as York. Falling to the north through York is a 3-mile grade of .2 or .3 per cent., down which a train will nearly run. The siding will hold between 95 and 100 cars, so that when it is a meeting point for more than two full trains, the second one to take the siding cannot get in to clear.

On the night of Oct. 8, 1907, we left Youngstown with 68 cars of coke, the usual "heady" work of our yardmasters being very apparent in the make-up of the train, new, heavy cars on both ends and a bunch of little, old, rotten coke racks in the middle. Everything ran along in the usual order until we arrived at this place called York. Several miles back we had received an order to meet two "southbounds" at York. Accordingly, after "tipping the hill" and giving the coke a pretty good shot down the grade, my engineer, whose name happens to be Jack for short, shut the throttle and we started to drift.

The engine passed the south switch going about 20 miles an hour, and just as she did, Jack made a light application of the brakes, holding them down to about 15 miles an hour, then releasing the train brakes, bunching what little slack there was, and then released the engine brake. We continued to drift to the north end, where we had to stop and the brakes acted the same as usual.

The first train we were to meet was there and in to clear. but the second

one was just pulling in. One of us happened to look back, and as no one had thrown the south switch in order to let the southbound out, and as three or four lamps were bobbing around back by the switch, we concluded the southbound had broken in two. And as the second one, with 90 cars, could not get in to clear before the first had gone I immediately began to hunt for a bed. However, my sleep was short, as a "brakie" soon came running up to the engine and crawling aboard said: "Hey, didn't you know you were broke in two?" And sure enough we were, about 20 or 25 cars back, the whole end having been pulled out of an old P. & L. E. coke rack. The hose in its tantrums had jerked itself around until the end had caught on one of the broken draught timbers and an effectual stopper, the equal of the angle cock, was then and there made, the hose being kinked so that no leakage of air through it occured. If we had not had to stop we would very likely have gone two or three miles, or until Jack or the head man awoke to the fact that our caboose was not in sight.

I think this has been the only occurrence of this kind on this division, but if anyone doubts the truth of it, three engineers and firemen and about ten trainmen saw it and their names are easily obtained.

Geo. C. Large.

Ashtabula, Ohio.

Thinks "L. E." is OK.

Editor:

I have read your "Coming of Age" in the January issue with pleasure, and I am proud of the fact that I have helped to make it what it is, and whatever success I have achieved as a locomotive man I owe to your paper. I can confirm your statement when you say its influence upon railroad men is of the highest value. I have read John Alexander with pleasure many times and often wondered who he was. I was at that time on Mr. Norman's list, when it was a small journal, and afterwards when the Locomotive was bursting through the cover, and I have most of those papers yet, and all the charts you mentioned. From a driver's point of view, the best of them all was the one explaining the angularity of the main rod.

Reminiscences of war times were read with interest at the time you published them, and away here in New South Wales, Australia, I admired the courage the men on the foot-plate displayed in such trying times. I have successfully passed an examination on the Westinghouse air brake, for which I must thank F. M. Nellis and Clinton Conger, and while I am aware of the fact that a man's success does not depend on what he knows about the brake, but what he does with it, it has saved me a lot of trouble many a time, and I might add, has got me into trouble when I repeated something I saw in your paper to the man that knew all about it before I was born.

If you look up your old files of letters you will see one from me asking Angus Sinclair out to Australia and we would convince him that, though they know something about railroading in America, it never prevented us from learning at the same time.

I hope that none of my fellow enginemen will think I hold a brief for your paper when I say that in my opinion there is no man living who has done more for locomotive men than Angus Sinclair, and I want to see the man that knows more about combustion than he does.

The splendid pictures of the eight-hour procession in Australia in your December issue help to prove what a large number of friends you have so far away, and not the least among them is Mr. A. Percival, a driver at Eveleigh depot. Mr. James Kennedy, in his paper, "Among the Railroad Men," seemed pleased to see some of the men worked 51 hours per week. I can add to his pleasure by telling him the drivers and firemen in N. S. W. work 48 hours for a week, or 96 for a fortnight. Any time over that is paid as overtime, and the pay is, drivers from 11 shillings to 15 shillings a day, firemen 8 to 10 shillings a day, and I believe that the men, as a whole, will compare with any other batch of railroad men in the world. The pleasure your success has given me compelled me to write this letter, and I trust you may live long to enjoy it.

Patrick Kirby.

Hornsby, N. S. W., Australia.

Oil Welding of Frames.

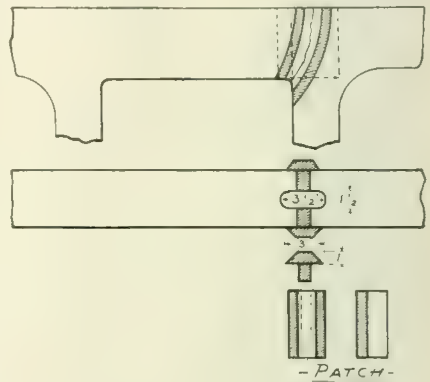
Editor:

My attention has been called to the article in your April number of Railway and Locomotive Engineering signed by Mr. C. H. Voges, general foreman, Big Four shops, Bellefontaine, Ohio, on the welding of locomotive frames by oil, claiming that this method originated in the Big Four shops at Bellefontaine, and showing that they had welded 71 frames since 1903.

I claim to be the originator of this process and you will find in your files description and photographs on the manner and method of doing this work, which was the first time it was ever published, several years before the time claimed by Mr. Voges.

I made the first weld of this description in June, 1899, in Oakland, Cal., and I believe you will recollect that you witnessed a weld of this description personally at Oakland some time later and made the remark then that it was entirely new to you. This process was not patented and I published the facts with full description and furnished detailed instructions to nearly all the large railroads in the United States. I would, therefore, like to have credit for it.

Several years after this process had been in vogue on this road, Mr. Voges wrote to Mr. W. F. Merry, then general foreman at the Tucson shops of this company, for further information and sketches of the process, which



FRAME READY FOR OIL WELD.

were furnished him. I am enclosing one of the blue prints which was sent to Mr. Voges at that time, which you will notice is nearly identical with the sketch published in the April number of your paper.

On this road I have welded over four hundred frames since the time you witnessed the one in Oakland, on all kinds of engines, and we have had a much smaller percentage of failures with the oil process than we had with the original blacksmith weld, or with the Thermit process. We generally use the oil, but under centain conditions and in close quarters we use the Thermit.

D. P. Kellogg,
Master Mechanic, So. Pac.

Los Angeles, Cal.

[A very full and complete description, with numerous illustrations, of frame welding by means of oil fuel by Mr. Kellogg was published in *Locomotive Engineering* for June, 1900, page 234. Mr. Angus Sinclair remembers seeing the operation referred to in Mr. Kellogg's letter. Mr. Kellogg was then foreman of the West Oakland shops of the Southern Pacific and the welding of frames had been in successful operation under Mr. Kellogg's direction when Mr. Sinclair visited the shops.—Ed.]

Good Luck to Micheals.

Editor:

No more touching scene was ever witnessed around the shops of a great rail-

road system than was seen on the Southern Railway when the employees of the Coster shops and the engineers of the Knoxville division met to say good-by to Mr. J. B. Micheals, master mechanic, who has been sent to Selma, Ala., to take charge of the shops in that city, leaving the Coster shops, in which he had been master mechanic for twenty-two years.

To know "J. B." as he was called on the road and in the shop was to love him. He knew the hardships of life as an apprentice boy and never turned the deaf ear to any one under him. To show their appreciation of his character the shop men purchased a handsome diamond stud and presented it to the man they loved.

The engineers looked upon "J. B." as a brother, for he too had been on the right side with his hand on the throttle and eye upon the rail ahead. To their brother, as they knew him, they presented a handsome solid gold watch and chain with masonic fob. The presentation of these two gifts were from the hearts of the men.

At the age of four J. B. Micheals was left an orphan and was reared in a good Christian home; reaching the age of 15, he secured a place as water boy of a construction crew on the Philadelphia & Reading. In his leisure time he drew a picture of a locomotive; the master mechanic, passing by, saw the picture and seeing the talent of the young orphan boy placed him at once in the shops of the road as an apprentice, where he began to learn his trade as machinist. Year by year he worked at his trade until he mastered it, and by strict attention to business he was made roundhouse foreman.

After filling the position of roundhouse foreman he was offered the position of general foreman in the shops at Marshal, Texas, which he accepted and filled with credit. Later he was offered the position of general foreman of the Louisville & Nashville shops at Nashville which he accepted, and after filling that position with credit he decided that he wanted to run a locomotive and was given a position as engineer on the road. He remained as engineer for five years. He then accepted the position with the Southern Railway as master mechanic at Selma, Ala., where he has now been sent. It was in 1886, when the guage of the road was changed on several Southern roads, that Mr. Micheals beat all other roads and divisions by one month and has the record in changing the guage of rolling stock.

He was then sent to Knoxville, which was the largest shops on the old E. T. V. & G. R. R. The shops then were small when the Southern took charge and under his supervision the old shops have been torn down and new ones built. They are known as the Coster shops, which are the largest on the system. For twenty-two years "J. B." has been in Knoxville. His record is one of the best. At the Coster shops every one regretted to see him leave. At the parting there were tears in many of the old men's eyes. All wish him success at Selma and all hope when the rotary system of the Southern comes into play again in two years he will be returned to the Coster shops, which he helped to build.

R. P. Williams.

Knoxville, Tenn.

Defects of the E. T. Brake.

Editor:

I noticed in your March issue that a subscriber hoped for a discussion on the defects in E. T. equipment and I think it is a good idea.

I ran across one myself a short time since, which could be considered in the nature of a freak, inasmuch as the combination of defects causing the trouble would seldom be found together.

When, with pressures at 70 and 90, and reducing valve set at 45 lbs. on the H-5 equipment, an application was made with the independent brake valve, brake pipe pressure would immediately equalize with main reservoir pressure. Brake pipe pressure when drawn down with automatic brake valve would resume normal pressure when placed on running position. Apparently there is no connection whatever between the independent brake valve and brake pipe feed valve, but we found after considerable skirmishing around that changing the latter for one that had been repaired ended the trouble.

Upon taking the defective one apart we found the small port through supply valve piston stopped up, the packing ring a very tight fit on account of dirt, and quite a leak around the flush nut. I considered that the piston being entirely air tight, the pressure on the front side of piston would drain out through regulating valve until greatly reduced. The slight variation of pressure on the other side of piston caused by the application of independent brake valve, aided by leak in flush nut, would probably disturb the piston enough to allow main reservoir pressure to force it to open position. I do not know that this is the correct explanation and would like to hear from others.

There seems to be a tendency among enginemen to blame the check when signal whistle blows after an independent application. I find that leaks in signal line cause this most frequently. The check being the dividing line, when the reduction is made the air is temporarily trapped and the leaks cause the whistle to blow.

Allen E. Nye.

Air Room Foreman,
A. T. & S. F. Ry.,
Albuquerque, N. M.

Boiler Explosions.

Editor:

The prevailing idea when a locomotive boiler explodes is that the immediate cause was low water in the boiler. This, however, to my mind, has never been satisfactorily proved, yet it seems to be the consensus of opinion among men educated in this line that insufficient supply of water in the boiler was the direct cause. The newspaper reporter will invariably decide "low water" was the immediate cause of the disaster and the public concur in condemning the lifeless and defenseless engineer.

Evidence has come under my observation that would seem to demonstrate the inaccuracy of this unreliable as well as uncharitable theory. Many years agone an instance came under my observation where an inexperienced man was assigned the work of firing a small locomotive after the boiler had been washed. In due course of time the locomotive got "hot" and it was the pride and the height of the young man's ambition to see the locomotive relieve herself through the "pop" valve. Presently he decided to satisfy himself of his ability to manipulate the injector and replenish the boiler with water. This part was successfully accomplished, but it was discovered that the boiler was leaking and the bright glow of the fire was extinguished. It was concluded that the reason for the crown sheet and the two sheets on the side of firebox leaking along the top row of staybolts was on account of the sediment around the crown bolts and the staybolts had been removed by the process of washing the boiler. Wonderful sagacity! The top row of flues were also leaking. Presumably the rest of the staybolts and flues did not have sediment and mud removed by the washing of the boiler. This locomotive carried 125 lbs. pressure to the square inch.

Later a road locomotive of the Wootten type had been "touched" while in service on the road and this one had identically the same kind of defects in the firebox sheets. Since that time perhaps fifty or more locomotive boilers that had similar treatment have come under my observation and all showed the same parts leaking.

A recent case happened that convinced me more firmly than any previous instance of similar character that low water and the effort to recover it will not explode a locomotive boiler in good condition. Arriving at the terminal the engineer directed the fireman to get his fire in shape and keep her "hot," as there was a "double header" to put away and it would require full pressure to handle all the cars. The fireman, who happened to be only a re-

cent addition to the force, did his part well as far as keeping the engine "hot" went. The train was put away in the course of twenty-five minutes or more and the engine was turned into the ash pit track still holding her full pressure and the fire all aglow. The engineer put on the injector to fill the boiler as usual preparatory to leaving her, and which was also required of him. At the ash pit he dismounted and began inspecting the engine, and before he had accomplished this part of his work the fireman told him there was a "leak in the top of the fire-box." By this time he had regained the water and there were two solid gauges of water. This engine was a modification of the Wootten locomotive and carried a pressure of 210 lbs. per sq. in. Every crown bolt and four rows of staybolts on either side were leaking, together with the top row of flues. This certainly was a case of low water in boiler and it was recovered and no explosion.

A short time ago my attention was called to a boiler that had just been "fired up" on account of a leak in the back end of the boiler, and that the attendant was alarmed and would not go near her. It was leaking profusely and when cooled down it was discovered that there was a crack about 16 ins. long on the outside shell of the fire-box. If this locomotive had exploded it would unquestionably have been attributed to low water, yet there was sufficient water in her boiler to last with perfect safety for several hours.

Early last fall my attention was invited to an explosion of a hot water boiler that was used for domestic purposes. This was a copper boiler and less than two years in use. The shell was knocked from end to end and did considerable damage to the property. Possibly the water was low.

A few years since a train of fast freight was speeding over a division and all at once a portion of her crown-sheet came down. The engineer was dishonorably dismissed from the company's service for incompetency as having allowed his boiler to become insufficiently supplied with water.

Immediately after this incident a twin sister of hers was taken in for boiler washing and general inspection. Thes eengines were comparatively new and were of the Wootten pattern. The inspection disclosed the fact that there were many stay-bolts broken and there were twenty-eight stay-bolts in one cluster broken.

The Board of Adjustment of the engineers became possessed of this information and the dismissed engineer was reinstated and is an honored employee of that road now.

In view of these incidents and others it would require copious and cogent argument to convince the writer that insufficient supply of water in the boiler, instead of the eternal destiny of matter wrought by the human mind and hand, is the immediate cause of locomotive boiler explosions. Yet the lifeless and defenseless engineer in the event of fatality who sacrifices his life on the altar of duty is ignominiously and perfidiously accused and condemand for carelessness and incompetency. JAMES FRANCIS.

Carbondale, Pa.

[Those of our readers who are interested in this subject should turn to our article on page 161 of the April, 1907, issue; also to the article on "Low Water Boiler Explosions," page 206, May, 1907, and to the one on "Causes of Boiler Explosions" in our September, 1907, issue, page 408, and to the remarks on page 407. Also to an article in "Twentieth Century Locomotive," page 164. In all these articles broken stays is held to be a prolific cause of explosions and low water is not held to be the immediate cause of an explosion. Low water means the long-continued heating of the dry sheets which soften, bag down and tear away from the stays, thus suddenly liberating the stored up energy in the water. If cold water is injected into the boiler before the sheet has been heated and weakened sufficiently to tear off the stays, then an explosion will not take place.

After an explosion has taken place there is no occasion for the reputation of anyone to suffer wrongfully. Broken stay-bolts show themselves as such and overheated and bagged sheets tell their own tale. Each has unmistakable characteristics which should not be mistaken.—Ed.]

Applying Cylinder Bushings.

Editor:

Different railroads have different methods of fitting and applying cylinder bushings and piston valve cages and I find they all work well if everything is all right, but in most shops the machinist trusts to luck, and if he happens to have poor luck the company is the loser. Now to do away with the idea of luck and avoid any chance of breaking the bushings, I have used the following method and have never had a failure.

The first and really most important thing to do is to make a pin gauge the same size as the bushing. This pin gauge can be made of ¼-inch round iron, pointed at both ends. There are several ways to heat the cylinder in order to expand it; however, I like to use a wood fire the best. After heating the cylinder try the pin gauge and if the pin gauge doesn't go in the cylinder easily don't try to put in the bushing, for the bushing heats quickly and will get stuck before you get it in. Ordinarily a cylinder will expand 1-16 in., and if the bushing is not turned too large a person can shove the bushing in by hand. After the cylinder cools off the bushing will be a perfect fit. If the bushing is too large, when the cylinder cools off the bore of the bushing will be out of round. I recently had to finish putting in a bushing that was stuck when half way in. I made my pin gauge and tried the cylinder and found the bushing 1-32 in. larger than the bore of the cylinder. I built a good wood fire all around the cylinder and as the cylinder got warm the bushing got warm and expanded as fast as the cylinder did. When the cylinder had expanded enough to take the pin gauge I cooled the inside of the bushing off with an air blast from the air compressor. In a few minutes the air blast cooled the bushing enough so I could drive it in with a block of wood.

MODERN 4-4-2 SOUTHERN PACIFIC.

In using a wood fire to heat the cylinder there isn't any danger of spoiling the cylinder, for an ordinary wood fire is not hot enough to melt cast iron, but in using a gas blower a person has to be more careful. Steam doesn't expand the cylinder enough.

The heavy part of the cylinder is on top, so takes longer to expand and that is where the most fire is needed. In building a fire in the bore of the cylinder, the cylinder will get a perfect heat all around, and in less than one minute after you sweep the fire out the bushing can be shoved in and there isn't any guesswork about it.

All bushings should be made the same size as the bore of the cylinder. It is always best to prove the latheman's work before even trying to put the bushing in.

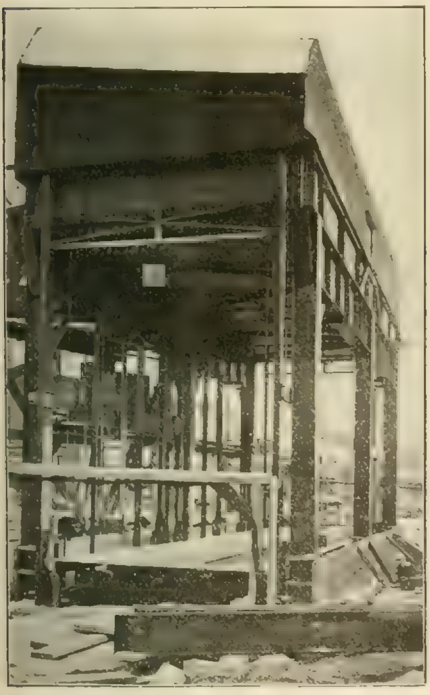
H. L. BURRHUS.

Erecting Shop Foreman,
Erie R. R., Hornell, N. Y.

Elevator for Cars.

An interesting elevator installation has recently been completed at the Hoboken terminal of the Hudson & Manhattan Railway tunnels under the Hudson river at New York. This elevator is for the purpose of placing in and removing from the tunnels and subway the electrically equipped passenger cars which are used in these tunnels. The elevator is in the yard of the Hudson Companies which adjoins the Hoboken passenger terminal of the Delaware, Lackawanna & Western Railroad. The cars are 48 ft. long, over all, by 9 ft. wide, and weigh empty about 64,000 lbs.; loaded with passengers they weigh about 85,000 lbs. To lower and raise these cars into and out of the tunnel a suitable lift has been built. It is an elevator of 100,000 lbs. capacity, with a platform 50 ft. long and 12 ft. wide

To provide for this elevator there is a well having reinforced concrete walls from the ground level to the tunnel. Upon the side walls of this structure are placed six steel columns supporting a steel girder framing directly over the hoistway, and upon these girders is



PASSENGER CAR ELEVATOR.

placed the machine for operating the elevator platform.

This machine consists of two drum shafts each 50 ft. long, one placed near each side of the well. These drum shafts are, at the center of their length, driven by a system of four balanced worm gears, arranged so that the load on all four worm gears is equal under all conditions of platform load. All thrust loads are balanced by the worm shafts, which have right and left hand worms operating the worm gears. These worms and gears run in oil baths in tight casings. The entire system of drum shafts, worm gears and worm shafts is driven by one 100 h. p. motor placed at the center of one side of the elevator machine.

The elevator platform is made with two longitudinal steel girders, one under each rail, with suitable steel framing to support the suspension sheaves whereby the platform is suspended from and operated by the elevator machine. At the sides of the elevator platform are dropped from the machine above, thirty-two steel cables, ¾ in. diameter, which pass under suspension sheaves below the steel plate floor of the elevator and return to anchorage in the steel overhead structure. By this arrangement one-half the load is suspended directly by the overhead structure, and one-half is suspended from and operated by the elemachine.

In addition to the machine cables the platform is suspended by eight counterweight cables, making a total of forty steel cables ¾-in. diameter. These have a combined strength of 1,552,000 lbs. The machine and cables are so arranged that the elevator platform cannot incline from the horizontal position, no matter where the load may be placed.

The elevator is electrically controlled by a pilot switch operated by a hand shipping cable, and the elevator may be run at speeds of from 10 to 20 ft. a minute. The platform stops automatically at the track levels. The rise of the elevator from the tunnel track to the surface track is about 30 ft. The platform is equipped with the third rail, which is "alive" only when the platform is at the track levels, so that the cars may be run by their own motors.

In addition to the usual lifting service this car hoist is arranged for quickly changing one or both of the motor trucks under a car body To. do this the platform travels 3 ft. above the surface tracks, and when in this position blocks are put in place under the car body, the truck connections are released and as the elevator platform descends, the car body remains on the blocks while the trucks go down with the elevator platform.

The lifting capacity over and above the weight of the elevated platform is 100,000 lbs. Weight of elevator platform, 32,000 lbs. Counterweights, 63,-800 lbs. The construction of the elevator is fireproof throughout. It has handled loads of 65 tons. It was built and installed by the George T. McLaughlin Company, Boston, Mass., under designs and patents of Mr. Martin B. McLaughlin.

New Style of Cab Window.

A correspondent has sent us the photograph, reproduced here, of a novel cab window. This window is set at an agle, probably about 45 degs., and by this arrangement it is said that the glare on the glass caused when the fire door is open is completely done away with. Our correspondent thus describes the window:

"Mr. C. M. Goodrich, an engineer on the Iowa Division of the Chicago &

GOODRICH CAB WINDOW.

North Western Railway, residing at Clinton, Ia., has devised a locomotive non-reflecting cab window which is a great success. This window entirely eliminates the reflection of light from the fire-box door on the front glass while the door is open. A recent test of this window was made through a blinding snow storm, on engine 895 on the fast mail, running at the rate of 60 miles an hour, for a distance of 60 miles. Owing to the diagonal position of the window the snow did not adhere to the glass in the least. The snow was at the temperature and the consistency to have done so on an ordinary window. During a test made on a 200-mile run there was not a landmark missed nor the view in any way obscured by the reflecting of light on the window, as is the case with the ordinary window when fire-box door is open. Any further information desired can be secured from Mr. C. M. Goodrich, 681 Tenth avenue, Clinton, Ia."

Remember the new address of Railway and Locomotive Engineering. It is 114 Liberty street, New York. We would like all our agents and correspondents to use the new address.

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Introduction of Balanced Valves.

No improvement introduced upon the locomotive came into popular use more quietly or more successfully than the balanced slide valve. When slide valves were small there was little need for any part of the pressure being removed by a balancing process. Before the introduction of the link motion, slide valves were made as small as practicable, but with the advent of the link, a movement went silently on of increasing the size of the valves to meet the requirement of enlarged steam and exhaust ports. For cylinders 16 x 24 inches steam ports almost as long as the diameter of the cylinders began to come into use and a construction rule of the early 70's was, to make the length of the ports two inches less than the diameter of the cylinders. With this rule of practice appeared the mathematician figuring on the immense load that had to be moved every time the valve made a stroke. According to the calculations, the labor expended in moving the valves made serious inroads into the efficiency of the engine. It took years to explode the exaggeration indulged in about the resistance of slide valves.

The sensational revelations of the loss of the power of a locomotive caused by the pressure on the large slide valves set inventors to work, and they produced such a fertile harvest of balancing devices that railroad officials came to dread the visit of a patent agent with a balanced valve in his grip guaranteed to save thirty-three per cent. of the fuel consumed by locomotives using unbalanced valves. The subject of balanced valves was for several years a perennial question for discussion by the Railway Master Mechanics' Association, but little good seems to have accrued from laborious investigations and exhaustive discussions. Many different forms of balanced valves were applied to locomotives, mostly through the recommendation of influential friends of the inventors. They performed very well for a time and glowing reports of their merits would reach the public, but when an engine having the wonderful valves passed through the back shop, plain valves were quietly but nearly always substituted.

That was the standing of the balanced valve when one day about 1875, A. B. Underhill, then superintendent of motive power of the Boston & Albany Railroad, received a visit from George Richardson, an old friend, who wanted to apply a set of balanced valves to one of the company's locomotives. Mr. Richardson had invented the valve and had great faith in its practicability. Mr. Underhill had endured some grief from balanced valves and insisted that they were a delusion and a snare. Mr. Richardson proved immovably persistent, for he had determined that a Boston & Albany locomotive was destined to prove the value of his invention. He was prepared to apply the valves himself without expense to the company, and to take them off at once if they were found not satisfactory. Those who knew George Richardson would predict that he would have his way and that was what happened.

The valves were applied to one of the largest passenger engines, and nothing was said about them, till four years afterwards, when the engine happened to be in the shop for general repairs. The shop foreman, who had been accustomed to seeing such valve novelties thrown into the scrap heap, went to Mr. Underhill and asked what was to be done with the Richardson valves. On examination they were found to be in perfect order and permission was given to leave them on the engine. They ran for nine years. Meanwhile their wonderful performance was reported to all likely to be interested, and the balanced valve quickly redeemed its reputation.

The Fallen Bridge.

The finding of the Quebec Bridge Commission is that the failure of the partly built structure over the St. Lawrence river was due to faulty design. The lessons to be drawn from the fall of the bridge are many and impressive. It was to have been a noble structure, and probably in new and stronger form it will be raised again to stand as a permanent triumph of engineering skill. The work is one of the greatest of its kind in the world, and, like other great enterprises, the first failure may be but a further incentive to the more careful and deliberate prosecution of the work.

The first Eddystone lighthouse, off the coast of Devonshire, built by Winstanley, was destroyed in 1703 by a hurricane. Rudyerd built the second tower on the Eddystone rocks in 1907, and it lasted for 46 years, until destroyed by fire. Smeaton's tower, built in 1759, has lasted until the present time.

The engineer is essentially the student of the forces of nature, and nature teaches her votaries by the severest of lessons—failure. Success with the engineer is not the winning of popular approval. His work is tried as that of no other is tried. A great lawyer may, by the sheer force of his eloquence, convince a jury that wrong is right. A great soldier may win a battle by reason of the unpreparedness of the enemy. A great surgeon may perform a difficult and daring operation and be successful by reason of the strong physical condition of his patient. The engineer stands apart from all these. He cannot convince nature that wrong is right. He never finds nature unprepared, and he may not dare for a moment to count on fortuitous conditions. His work, if it deviates from the rigid standard imposed upon him by nature, will fail.

Nearly every one who reads these lines knows from actual experience how exacting is the labor, and how implicit the obedience required from those who do work in obedience to the laws of nature. You cannot neglect the laws of friction and make an engine run. You cannot overlook the water supply to the boiler, and make up the deficiency in other ways. Nature takes no account of tired body or jaded faculties. Physical law never forgives "I forgot." The man who attempts to do the work of an engineer, be it constructive or operative, can never

falter, and he can never plead excuse.

It is these very things above all others which constitute the nobility of the profession. The engineer submits his work to a judge impartial and severe, in whom there is no caprice and to whom no cojolery will appeal. His most faithful and conscientious effort is weighed in an even balance without the addition or subtraction of a feather, and the scale turns with absolute fidelity to truth, unmixed with flattery or rebuke.

In modern engineering work no Athene springs fully accoutered, on the instant, from the brow of Jove. With us to-day there are toilsome steps in the evolution of the individual as there is and was in the evolution of the race. The ability to achieve is often the measure of the preparation.

The engineer's work stands, not by reason of popular approval, but because of its inherent worth. There are many seeming contradictions to this in the experience of us all, but the promising short cuts generally turn out to be mistaken paths, and for the engineer the longest way round is the really shortest way home. The lesson to us who read the verdict on the fallen bridge at Quebec is that failure is not the end of endeavor but rather the sign post pointing out the sure and safe road. It is not for us to smile self-righteously at the mistakes of others, but to look well to our own performance. The engineer has voluntarily entered a severe and exacting service, but it is in itself the most noble on earth, for its achievements are beyond the praise or blame of man.

Attempts at Heat Saving.

One of the fruitless dreams of philosophers and physicists has been the devising of some method by which the energy of fuel could be converted into work without being turned into gas or without being employed to boil water for the purpose of steam generation. The gas engine has made an important step in utilizing the potential energy of fuel, but that form of prime mover has limitations that will keep the steam engine in use as long as the human understanding can penetrate the veil of engineering progress.

It is a curious and interesting study to follow the mutations of progress connected with the use of steam from the earliest efforts to convert fuel into work, up to the comparatively perfected engine of today which produces one horsepower from each pound of steam used, but does not utilize more than 10 per cent. of the energy of the fuel. That seems to be a very small triumph of scientific effort covering several centuries, yet represents the improvement obtained by the most brilliant thinkers and most accomplished inventors of three centuries. Three centuries cover the investigations and experiments that developed the modern steam engine, but many centuries have elapsed since scientific speculators discovered that steam could perform work.

There is no means of knowing when the potential power of steam was first discovered. A cooking vessel covered by a lid first supplied the means of producing steam with pressure greater than the atmosphere. Observant housewives soon perceived that holding in the savory fumes arising from the boiling broth tended to bring out the essence of the meat. A piece of cloth employed as a liner to the lid helped to make the latter steam-tight. A stone placed upon the steam-tight lid produced pressure. When the pressure proved too great and the caldron exploded, popular ignorance attributed the accident to diabolical agencies; but now and again an observant person appeared who attributed the accident to the true cause. The person who could reason out the truth on such an incident was a philosopher, one of the class that separated fallacies from fictions and whose work added to that of many others built up the science of the line upon which their labors were devoted.

The first important accumulation, of what might be termed engineering knowledge, was made in connection with the great Library and Museum of Alexandria, in Egypt, founded three centuries before Christ by Ptolmey Sotor. The Alexandrian Library was the greatest seat of learning which the ancient world possessed. Connected with it were such names as Aristotle, Archimedes, Euclid, Etesibius, Hero and others whose names are familiar to modern scholars. Among the engineering curiosities described in a book found in the Alexandrian Library was a steam motor that had been used for doing such light work as closing church doors, turning cooking spits, etc. Hero, of Alexandria was credited with inventing the æolipile, as the engine was called, but some historical authorities doubt this, holding that Hero merely left a description of the apparatus.

The æolipile appears to have survived all the vicissitudes connected with first a crumbling and then a renaissant civilization, and was familiar to the people who devoted themselves to the developing of a steam engine capable of performing the drudgery of the world and of carrying the heavy burdens of mankind.

Hundreds of investigators and inventors before Watt's time left beneficent marks upon the steam engine, but their sole aim was to produce an apparatus that would work for days without failure. The idea of saving heat does not appear to have influenced any of the pioneer steam engine makers. John Smeaton, a celebrated engineer, who labored to improve the Newcomen engine, was the first to attempt heat saving. He applied wooden casings to the pistons to prevent changes of temperature, and he also applied a feed water heater to the hot well. James Watt, who was well informed concerning heat phenomena, designed the separate condenser to prevent the waste of heat due to the alternate heating and cooling of the cylinder. When Watt's engines were first offered to the public, they came into competition with Newcomen engines and were guaranteed to do certain work on greatly reduced consumption of fuel. The competition that ensued brought fuel saving into active prominence.

After the invention of the separate condenser, the most important work that Watt performed, in the interests of heat conservation, was the inventing of the steam jacket. With the long stroke, slow moving engines of Watt's time, there was great loss of heat from the steam condensing in the cylinders. To remedy this evil Watt had a steam-tight casing made with the cylinder, into which live steam from the boiler was applied. This steam jacket prevented cylinder condensation when it was used properly, but under the management of ignorance and carelessness, the steam jacket has often acted as a steam condenser that increased rather than diminished the steam condensation naturally due to the cooling action that follows the reduction of cylinder temperature due to the expanding steam.

When the high pressure high speed engines were first introduced, their friends and promoters assumed that the trouble from cylinder condensation would be ended; but a few years' experience demonstrated that the old cylinder condensation drawback was present no matter how high the steam pressure might be or how fast the piston might travel. The remedies for loss of heat by cylinder condensation in high pressure cylinders have been legion, and every year brings the introduction of new ones. The locomotive engine has borne the greatest burden of experiments carried out to increase the efficiency of the steam used, and there is no indication that experimenters are discouraged by their lack of success. The practice of double expansion was introduced with the idea that cylinder condensation would be materially reduced, since extremes of temperature would be avoided when the steam was expanded in two cylinders instead of in one; but the compound locomotive has not proved a brilliant steam saver. Now we have

come to the point where the argument is used that the proper way to prevent loss from cylinder condensation is to heat the steam so intensely that losses of heat from doing work by expansion or from the interaction of the cooled cylinder metal, will not be sufficient to cool the steam to the dew condition. This is known as superheating.

The practice of superheating steam is by no means new, for it has been tried, abandoned and tried again, long before any of the present generation of engineers was born. That erratic inventor, Richard Trevithick, inventor of the first locomotive to run on rails, was the first engineer to experiment with superheated steam. That was in 1828. A heat saving of about 33 per cent. was claimed for the superheating arrangement. A special form of superheating boiler was patented by Trevithick shortly after his first experiments were carried out, but this boiler did not become popular. Many insulated experiments were made with superheaters between 1830 and 1850 and claims for great steam saving were always made, but for various reasons the superheating appliances were quickly abandoned. Their engineering reputation went up like a rocket and came down like the stick. About 1860 a movement originated to apply superheaters to marine boilers, and the prospects of success seemed very bright at first; but the hot steam soon fell into disrepute, principally on account of trouble with stuffing box packing burning out. There was also difficulty with lubrication of valves and pistons. The writer made several trips in the engine room of a steamer that had a superheater in the uptake. On the last trip it burned out and caused some delay, which ended its service. A peculiarity about superheaters has been the readiness of users to become discouraged by difficulties.

Superheaters for locomotives have lately come into much favor in Germany, and they are reported to be saving a large percentage of fuel. The Canadian Pacific Railway people have applied superheaters to over three hundred locomotives and are still extending the use of that heat saver. If that railway company can reduce the fuel bills by the use of steam superheaters other railroads ought to profit through the same source.

Pounding.

On the east coast of North America it is a singular circumstance that in every kind of disease that afflicts frail humanity, malaria is nearly always mixed up with it. The tendency to contract this trouble when the body is weakened by some other cause is very great. There is something analagous to this in the locomotive, for whatever else may happen to the complex mechanism of the great machine, there is almost always a pounding somewhere in the multitudinous joints or bearings of the engines. The causes are many, but, generally speaking, the trouble may first be looked for in the driving boxes, and those who have had opportunities to observe the exact condition of locomotives in service will agree that the conditions of the wedges in their relation to the driving boxes is the chief cause of the pounding so frequently complained of in the running of the modern locomotive.

It is a remarkable fact that no matter how carefully fitted the wedges may have been when the locomotive was constructed or repaired, the boxes will be found sooner or later to be rocking in the wedges. Very frequently the wedges loosen themselves. More often they are loosened by the engineer while in service and especially when a tendency to heating may have manifested itself during the strenuous period while the engines are in operation. The attitude to loosen the wedges too much is very great among railway men. This habit is fraught with the most deplorable results and it is safe to state that the great majority of frame fractures are due to the loosening of the wedges, thereby allowing the shock of the piston to strike with great force against the pedestal jaws. This fact is particularly emphasized by the frequent breaking of the right frame which, as is well known among railway men, is subject to greater shocks than the left frame. These shocks or blows are greatly increased in intensity when the driving boxes are loose in the wedges, and apart from the risk of frame fracture, there is a rapid wear of the wedges and boxes and a cutting begun on the pedestal jaws which in a short time renders it impossible to establish a correct adjustment of the parts.

In fitting the wedges in the machine shop it is good practice to leave them narrower in the bottom than at the top. It will be found that when the weight of the engine is placed on the driving boxes there usually arises a slight contraction of the bottom of the boxes which facilitates the rocking of the box. This is obvious from the fact that wedges are nearly always more worn on the top than on the bottom. It seems incredible that the driving box could contract at the bottom, braced as it is by a cellar of thick metal fitted tightly between the two sides of the box, but it will be found by actual measurement that there is a considerable contraction after service. Hence, in the fitting of the wedges, as we have already stated, the space should be slightly narrower in the bottom.

The loosening of the wedges, while in the cases of boxes being heated, may be an absolute necessity, care should be taken that as the box cools the wedge should be returned to its proper position as speedily as possible. The operation is simple enough and need not occupy more than a few minutes. The wedge should first be tightened up as firmly as possible and a mark may readily be made on the frame, and the wedge drawn down one sixteenth of an inch below this mark. Both the wedge and shoe should be equipped with tap bolts passing through a slot in the frames. If these are kept tight the liability to cut the pedestal is eliminated altogether. Both the wedge and shoe should also be reduced on their faces by planing off a portion of the bearing part, leaving their fitting surfaces about the same length as the face of the box. This will preclude the possibility of the box cutting into the surface of the wedge, leaving a ridge on the upper part of the wedge into which the box may become jammed at any time by some extra vibration of the springs. It may be added that in setting up the wedges it is well to observe that the engine is in such a position with relation to the action of the rods that the boxes are being pulled firmly against the shoes, otherwise the pressure of the driving box may be set strongly against the movable wedge and prevent its being readily set to its proper position.

Proposed Changes in the M. C. B. Code

The standing committee of the Pittsburgh Railway Club recently made a report on the revision of the M. C. B. rules of car interchange. Want of space prevents us from reprinting the report in full, but among the suggestions was one about pencils. They want black indelible pencils to be used in making out defect and bad order cards, and wish that the use of such a pencil be insisted on in the rules. This suggestion arises from the fact that many car inspectors do not use ink and ordinary lead pencil writing soon becomes indistnct.

A proposal is made to print the cards so that the car number and initial shall be at the bottom and not at the top of the card, as it is now. The reason for this is that bill clerks and others who handle the cards usually get them fastened to other papers, vouchers or letters. These are either pinned or held together with a clip, and the fastening is usually placed so as to obscure the number of the car, and it is frequently necessary to detach the card from the other papers in order to see the number. This may not seem to involve much trouble, but when it has to be done all day and every day, the few moments taken for each card when added together shows considerable loss of time.

Coming to the practical inspection of cars, the suggestion is made that in the rule dealing with seams on the

tread of a cast iron wheel should read "Any seams at a distance one-half inch or less from the throat of the flange." As the rule is now, wheels may be removed for seams one inch long or over when found at a distance of half an inch or less from the throat of the flange. The report says, "Any seam in the throat of the flange is dangerous, inasmuch as it is impossible to determine from a surface inspection the length of the same, as it very frequently shows at the surface, a certain length and then extends further under the surface." In rule 14 the addition of the word "cracked" in the first line is suggested, because when wheels are discovered to have cracked flanges, due to seams, they should be removed from service, from a safety standpoint.

There is also a suggestion which deals with the ambiguity as to which is the "inside" of the flange as specified in rules 18 and 20. When an inspector is required to gauge wheels for a bent axle, he measures the wheels between the "inside" of the flanges, which means from the backs of the flanges. This side of each flange, the Pittsburgh Club Committee desire, in rule 18, to designate by the expression "the opposite side from the throat of the flange." This certainly removes the ambiguity arising from the words "inside" and "outside" of the flange. It seems to us, however, that the sides of the flange might be clearly designated by calling one the "side adjacent to the tread," and the other or the back of the flange, the "side remote from the tread."

Another suggestion regarding wheels is that in rule 21 the gauges shown in Figs. 1, 2, 3, 4, 4A, and 5 be changed so as to eliminate the throat radius. The reason for this suggestion is that the gauge shown in the M. C. B. code has a 3/16 in. radius at the throat of the flange, while the gauge shown among the M. C. B. standards adopted last year provides for a ⅜ in. throat radius. The gauge proposed by the committee of the Pittsburgh club is intended to measure wheel flanges at a point ¼ of an inch above the tread and it is sugsuggested that the opening in the proposed gauge should be made to condemn the same thin flange wheel, that the present Interchange Code gauge condemns. This would approximately be an opening of 1 inch on the proposed wheel gauge for a wheel which would be condemned with a flange $1\frac{1}{8}$ ins. thick by the present gauge. The second opening in the proposed gauge would be approximately 15/16 of an inch for a wheel which would be condemned with the present gauge for a 1 in. flange. The decrease in the openings in the proposed gauge is owing to the flange being measured at a point higher up from the tread than the present gauge. By eliminating throat radius the proposed gauge can be used so that differences of opinion will not exist, for it is intended that the proposed gauge shall not condemn a wheel until the bottom of the outer end of the gauge rests squarely on the tread and so remove the uncertainty now existing by reason of the possibility of the inspector tilting the present gauge toward or away from the tread.

First Aid on the B. & M.

The second regular course of lectures on "First Aid to the Injured," delivered to the employees of the Boston & Maine Railroad has recently been completed. Dr. H. M. Stoodley was in charge of the course and delivered ten lectures to a large and attentive class.

This course is the outcome of arrangements made with the National First Aid Association of America by the Educational Committee of the Railroad Department of the Y. M. C. A. in Boston. This work has the hearty endorsation and co-operation of the B. & M. and the railway contributes to the undertaking, with the understanding that the lectures are free to all employees of the road. Mr. Frank Barr, third vice president and general manager of the B. & M. is a firm believer in the benefits to be derived from first aid instruction to railway men and his belief takes this kind of practical shape.

Following each lecture, the students are taught how to do bandaging by practical demonstration with each other in class. The proper methods of administrating temporary relief in cases of injury, shock, hemorrhage, dislocations, burns, and other accidents are clearly explained. Each student is supplied with the Barton First Aid text book, and an instruction package containing an illustrated triangular bandage, roller bandages and finger splints.

The excellent work done by the National First Aid Association, of which Miss Mary Kensel, of Boston, is the secretary, needs no encomium from us. We have before now taken occasion to remark in these columns that First Aid in railway work does not aim at turning good railroad men into poor surgeons. The scope of the work is rather to eliminate error in the treatment of injured persons and to familiarize railroad men of all ranks with the easiest and best way of rendering that help which all desire to give in cases of emergency.

The knowledge of how to act gives confidence, excludes misdirected effort and prevents conflicting and confusing attempts to render assistance. First aid is rational and is founded on common sense and when practised by kindly and enlightened men is a powerful agent for the banishment of unnecessary suffering and pain.

Exhibition of Safety Appliances.

The opening of the American Museum of Safety Devices took place last month at 231 West 39th street, New York. Among the articles on exhibition may be mentioned lighted lamps that will not explode when turned upside down, containers through which lighted gasoline can be poured without exploding, an Industrial "chamber of horrors," a model house fire-proofed within and without, a mine gallery constructed with steel instead of wood, with lagging and fudged with coal, safety davits, signal lights, life buoys, collapsible life boats, occupational dusts, ambulances and emergency boxes. There was no charge for space, as the object of the exposition is not coercive, but suggestive. Inventors and makers are invited to communicate with Dr. William H. Tolman, director, at the Museum.

Among the exhibitors were the Carnegie Steel Company, Westinghouse Air Brake Company, the American Bridge Company, the Union Switch and Signal Company, Yale & Towne Manufacturing Company, the Travelers' Insurance Company and others. Three solid gold medals were awarded for the best devices in transportation, mining and the best safety device for motor boats and motor vehicles. The chairman of the committee of direction is Mr. Charles Kirchhoff, and of the exhibits committee, Prof. F. R. Hutton. The Museum is a permanent institution of unique educational value, and is deserving of generous support.

Book Notices

Power and Power Transmission. By E. W. Kerr, M. E. John Wiley & Sons, New York. 366 pages. 6 ins. X 9 ins. Cloth. Price, $2.

The subject matter of this excellent book is largely composed of a series of lectures delivered by the author in his capacity of Professor of Mechanical Engineering in the Louisiana State University. The book has already been received with much popular favor and the second edition is being rapidly distributed among the younger engineers at home and abroad, and to them the work cannot fail to be other than a strong directing force along the proper lines of study. The paper and presswork are of the best, while the drawings, both mechanical and perspective, are such as stamp the book at once as a careful and painstaking effort to treat an important engineering subject in the way that it ought to be treated. It will be read with interest and profit by all those interested in the subject.

Electrical Railroading. By Sidney Aylmer-Small. F. J. Drake & Co., Chicago. 924 pages, 4¾ ins. x 7 ins. Flexible leather. Profusely illustrated. Price, $3.50.

The recent adaptation of electrical power to city and urban railway traffic has brought the subject of electrical railroading prominently to the minds of the younger class of railroad men and those who will take pains to possess themselves of a knowledge of the subject cannot fail to realize the advantage they will gain in a few years. The work before us admirably suits the student who may not have the opportunity of attending college classes. There is in this book all that a railroad man needs to know. The book consists of a series of lessons, and each lesson has the merit of being short enough to be studied at one time. The popular style of questions and answers is largely adopted. Full descriptions of apparatus and machinery give a fullness to the work which cannot fail to fix the subject thoroughly in the student's mind.

Locomotive Catechism. By Robert Grimshaw, M. E. N. W. Henley Publishing Co., 132 Nassau street, New York. 816 pages, 5 x 7½ ins., ornamental cloth, illustrated with 437 engravings and 3 folding plates. Price, $2.50.

A new edition, revised and enlarged, of Mr. Grimshaw's popular Catechism has just been issued and will undoubtedly be received with much popular favor. It is gratifying to observe that authors and publishers are alive to the fact that the young railroad man of to-day is looking for the fullest information on the details of the modern locomotive, and the supply seems to be keeping pace with the demand. The fine typography and binding, which are characteristic of the Henley publications, is more than maintained in the work before us, while the quality of the illustrations leave nothing to be desired.

Railway Shop Up to Date. Compiled by M. H. Haig and B. W. Benedict. Crandall Publishing Co., Chicago. 243 pages. 9 ins. x 12 ins. Cloth. Price, $4.00.

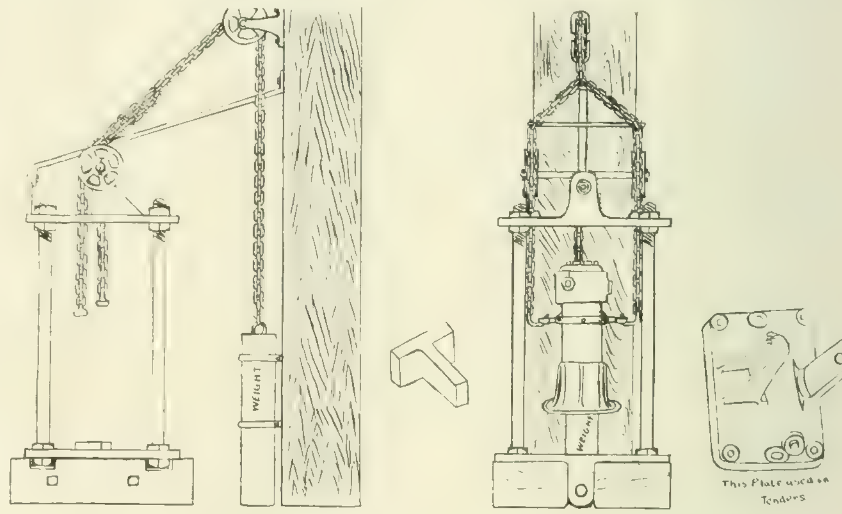
The necessary revolution that has taken place in machine shop construction in recent years is such that the bringing together in one volume of a variety of descriptive designs, each complete in itself, cannot fail to meet the warm approval of all who are interested in the involved problem of railroad shop construction. The work is comprehensive in its scope and the arrangement of details is logical and shows how carefully the editors have conned their subjects. The various departments essential to locomotive and car construction and repair are classified under separate headings and the work is altogether a valuable reference on the great and growing subject of which it treats. The numerous drawings are clear and comprehensive. The letter press is excellent. The subjects are treated with a lucid terseness that is commendable.

Easily Made Rod Press.

A handy rod-brass press has been devised by Mr. Edward Schultz, general foreman of the Chicago & North Western Railway at Milwaukee, Wis., which we are able to show in our line cut made from a shop sketch. The base casting is a plate used on the tenders belonging to the C. & N. W., and it is set in wooden blocks so that the lugs help to hold it in place and the bottom of the casting forms a plane surface.

Two upright rods hold a simple T-shaped forging the top of which supports the bearing for an axle and a pair of small guide wheels. The main part of the whole arrangement is an ordinary hydraulic jack such as is used in the shop and this jack is supported by chains terminating in a counterweight which slides loosely in a pair of guides fastened to one of the posts in the shop. The jack is thus easily arranged so that its base may rest on the plane surface of the base casting or the top of the jack may be made to bear against the T-shaped forging on top. This is a matter of convenience for the man using the machine as the jack will do business just as well if the base is jacked down or the head is forced to rise.

The jack being hydraulic is, so to speak, self-contained and is always ready for use. The whole thing is handy, it takes up very little room, it can be made of material which is to be found in any shop, and furthermore if the jack is wanted elsewhere it can be unhooked from the chains in the twinkling of an eye and used anywhere about the shop, but when in position as a part of this apparatus the everyday shop jack rises to the dignity of a small hydraulic press, and under its persuasive pressure the brasses sink slowly into the holes in rod ends and stay there.



ROD BRASS PRESS, MADE IN C. & N.-W. SHOPS, MILWAUKEE, WIS.

Proud of His Occupation.

"I am proud of my occupation of locomotive engineer," wrote John Alexander, "and the responsibilities I assume. I cannot think of anything I would care more to hear of one of my sons than for some man who knows what he is talking about to say: 'That young man is a first-class locomotive engineer.'

"Enginemen of America, what does that remark mean? To a workingman it means a skilled mechanic capable of earning from two to four times as much pay as a laborer. To the railway officials of the country, a man in whom they can safely trust the trains and property of the road, safe in his decisions, cool in emergencies, and faithful to his trust. To the thinking public, a hero whom it will be perfectly safe to trust with the lives of the dearest ones on earth. To his family it means sobriety, thrift, manhood. To his friends kindness, benevolence, honesty, honor as a good example. To society, a man and a gentleman, intelligent, grimy-handed and square.

"A fireman's position bears the same relation to an engineer's as does a lieutenant's to a captain's—eventually he takes his place."

What Should a Young Fireman Know?

A modest young fireman has written to us, asking for an outline of the knowledge a man in his position ought to be possessed of in order to make a first class fireman. We have referred him to the instruction and rules given in certain books, but we are by no means sure that we have covered the subject properly. We should be pleased to hear from our readers on the subject, particularly from traveling engineers.

Time wasted is Existence; used is Life!—*Young.*

Applied Science Department

Elements of Physical Science. XIII.

OPTICS.

Light is believed to be produced by the undulations of ether, a subtle and elastic fluid that fills all space. The vibrations of the atoms of luminous bodies wherever situated set waves of ether in motion like ripples on the surface of water. The number and velocity of these vibrations are incalculable, but their effect upon the membrane of the eye produce the sensation called light.

Optics is the science that treats of the phenomena called light and also of the faculty of vision. In the transmission of light, all bodies are divided into three classes—transparent, translucent and opaque.

The chief source of light, as of heat, is the sun. Light is also in a lesser degree received from the stars, electricity, chemical and mechanical action, and phosphoresence. All other sources of light are insignificant in comparison with the light of the sun. The most dazzling combination of light that can be brought together within a few feet of us is obscured in the light of the sun at a distance of over 90 millions of miles.

The fixed stars are also self-luminous, being suns of other systems. The immense distance that separates them from our planetary system renders their light of little importance to us. When the sun shines, the most luminous among the fixed stars become invisible. In regard to the degree of light supplied by the sun it may be noted that in comparison with the light of the full moon, the former exceeds the latter nearly 550,000 times.

The velocity of light has been carefully ascertained by repeated experiments and light is said to travel from star to star at the rate of about 185,000 miles per second. At this velocity light travels between the sun and the earth in about eight minutes. The velocity of light was discovered by Roemer, a Danish astronomer, who carefully calculated the appearance of the moons of Jupiter when rising behind the planet's disk at a time when the Earth was nearest to Jupiter and then observed the phenomena when Jupiter was at its furthest point from the Earth. At the more remote distance the moons were sixteen minutes later in appearing than at the nearest point. The graduation of the intervening distances was found to be correct as Roemer had anticipated and the phenomena could not be accounted for on any other theory than that of the time required for light to travel.

REFRACTED LIGHT.

It will be observed that when light strikes a transparent body some of it is reflected and some of it is partly absorbed and partly transmitted through it. If the light comes from any other angle than at right angles the direction of the rays of light are modified by the resistance of the transparent body. Thus, when an oar is placed in the water it no longer appears to be straight but appears as if broken at the point of contact with the water. It is evident that the rays of light on entering the water are slightly deflected by the resistance of the water, with the result that a change of direction occurs, so that bodies immersed in water are not exactly located where they seem to be. The same phenomena is true in a lesser degree in regard to the true position of the heavenly bodies. Except when directly at right angles, the light from them is deflected from its straight course by passing through the atmosphere with the result that these bodies are not in the position where they seem to us to be. This change of direction which a ray of light experiences on passing obliquely from one medium to another is called refraction.

Many of the effects of the refraction of light are unobserved to us, as in the case of the rising and setting of the sun. We actually see the sun before it has risen above the horizon, and it remains visible for some time after it has set. We also owe the twilight to successive refractions of light after the sun has disappeared. Anyone doubting this phenomena can be readily convinced by placing a coin on the bottom of an empty vessel and hold the eye in such a position that it will just miss seeing the coin on account of the side of the vessel coming between the eye and the coin. Let water be poured in, then the coin will become visible, the rays having become refracted or bent so as to meet the eye. In the case of the sun or other heavenly bodies, the atmosphere acts on the rays of light although in a much lesser degree than the water, because the air is a thinner fluid.

Attraction Toward Lights.

A scientific puzzle is, why does the moth fly to the candle and why do all sorts of nocturnal insects fly to the fatal electric light? There are many theories on the subject. Professor Loeb sees in the insect's flight candleward only a directive effect of light similar to that which causes the flower to turn towards the sun, while others ascribe the effect purely to the insect's curiosity. One authority notes that only flying and swimming creatures are thus affected, and he explains this by reminding us that such creatures must rely for their guidance almost wholly on sight. Hence a bright light in the night attracts them, because it gives rise to the sole external impulse that can act upon them.

Importance of Water.

Writing in the Century Magazine, Professor Lowell makes some very striking points on the importance of water in making the earth a dwelling place of animate beings. He says:

"Of all the conditions preparatory to life, the presence of water, composed of oxygen and hydrogen, is at once the most essential and the most worldwide. For if water be present, the presence of other necessary elements is probably assured. If water exist, that fact goes bail for the necessary temperature, the gamut of life being coextensive with the existence of water as such. It is so consequentially, life being impossible without water. Whatever the planet, this is of necessity true. But the absolute degrees of temperature within which life can exist vary according to the mass of the body, another of the ways in which mere size tells. On the earth 212 deg. Fahrenheit limits the range at the top, and 32 deg. Fahrenheit at the bottom in the case of fresh water, 27 deg. Fahrenheit in the case of salt. On a smaller planet both limits would be lowered, the top one the most. On Mars the boiling point would probably be about 110 deg. Fahrenheit. Secondly, from the general initial oneness of their constituents, a planet that still possesses water will probably retain the other substances that are essential to life; gases, for the reason that water vapor is next to hydrogen and helium the lightest of them all; and solids, because their weight would still more conduce to keep them there. Water, indeed, acts as a solution to the whole problem.

Remedies for Burns and Scalds.

People who are liable to suffer from accidental burns or scalding would do well to keep in a convenient place a bottle of linseed oil and limewater, together with a roll of absorbent cotton and pieces and strips of old linen for bandages. For scalds an application of glycerine is most useful. Strips of linen or lint, well soaked in glycerine, gently laid over the scalded skin immediately after the accident, will afford relief from pain and hasten a cure.

Questions Answered

SAFETY VALVES DURING BOILER TEST.

(36) R. E. L., Culebra, C. Z., writes: In giving any boiler a hydrostatic test of 50 per cent. above the regular working pressure, which is the best practice? To screw the spring down in the safety valve to withstand the extra pressure and then set the safety valve to its regular working pressure afterwards, or to plug up the hole after safety valve has been removed from the boiler, or to gag the valves? A.—In testing boilers the best practice is to remove the safety-valve springs and place pieces of pipe on the valve stems, then screw caps down on the pieces of pipe. These will hold the valves in their places against any pressure. It is not good practice to screw down the springs, as the limit of their resistance might be reached and the spring be permanently damaged. Plugging the valves from the inside involves the removal of the dome cap if it is desired to save the plugs. In any event wooden plugs are unreliable against high pressures. Gagging the valves is not good practice, because cases have been known where the gagged valves have been forgotten after the test was completed and steam raised with valves in this condition.

CROSSHEAD MOTION.

(37) J. H. C., Meridian, Miss., writes: What part of the cylinder does the piston travel the fastest in? Is it from the centre to the front end and back to the centre, or is it from the centre to the back end and return? I believe it is from the centre to the front end, but my friend thinks it is from the centre to the back end. Which of us is correct? A.—You are right. This question depends on what is called the angularity of the connecting rod. When the crank pin is on the top or bottom quarter, the crosshead is slightly back of the centre of the guides. Call this position anything you like as long as you understand it. Say it is the "nearcentre" position for sake of argument. From nearcentre to back-end of guides and up to nearcentre is the to and fro motion of the crosshead for the crank pin's sweep up from bottom to top quarter, running forward. That is half a revolution for the wheel. From nearcentre to front end of guides and back to nearcentre is the to and fro motion for the crank pin's downward sweep from top to bottom quarter, running forward. If the motion of the wheel is at the same rate all the time, the crosshead will have to go from nearcentre to front and return to nearcentre, in exactly the same time that it goes from nearcentre to back end and return to nearcentre, and as the distance from nearcentre to the front end is longer than from nearcenter to back end, the crosshead moves in the forward part of the guides slightly faster than it does in the rear part.

EXPANSION OF PLATES.

(38) R. A. C., Angelica, N. Y., writes: Please answer the following: Which will expand the most when heated, a one-inch hole in a six-inch piece of iron, outside diameter, or a one-inch hole in a twelve-inch piece, outside diameter? A.—The expansion is greater in the larger piece, for the reason that the larger the body of metal the greater the amount of expansion when heated. In a series of experiments, made with a piece of boiler iron three-eighths of an inch in thickness, the variation was not great, but each occasion showed that the expansion was slightly greater in the larger plate. The whole piece of metal has in each case to be heated.

MEETING OF WORK EXTRA AND REGULAR.

(39) A. H., Wheeling, W. Va., writes: Suppose A, B C and D are stations on a railway. No. 20 is a second-class train, northbound. The following order is sent to operators at A and D simultaneously, addressed at A to No. 20 and at D to Engine 7852. The order reads, "C & E No. 20. A, also C & E Eng. 7852. D.—Eng. 7852 will work 9 A. M. until 3 P. M. between D and A and will meet No. 20 Eng. 8126 at B." The event turns out that No. 20 arrives at B at 3.15 P. M. and the work extra Eng. 7852 is not there and no notice of having been there. The question is, will No. 20 fulfill the "meet" order or assume that work extra Eng. 7852 is dead after 3 P. M. and proceed?—A. It is not good practice to give a "meet" order to a schedule train and a work extra, because the work train may move in either direction within its working limits. In the example you give, No. 20 should ask for orders at B. A ruling of the American Railway Association dated Sept. 7, 1893, is to the effect that the regular train could not pass the meeting point without orders and the work extra has no right of track after its time limit of work had expired. The Association also rules that under the circumstances Form E, a time order, should have been used. The reason for this would appear to be that using the kind of order you quote there arises a doubt, such as you have indicated, as to what is the proper course to pursue. But when the time order is used there is no such uncertainty because each train crew knows what the other will do.

WALSCHAERTS GEAR AND WEAR OF BOXES.

(40) J. B. E., Newark, Ohio, asks, Does the Walschaerts valve gear wear the driving boxes more than the Stephenson motion, and if so, to what extent?—A. The experience of a master mechanic on an important railway which is using the Walschaerts valve gear extensively is that the wear of the driving box brasses is greater with the Stephenson motion than with the Walschaerts gear. He says, with the reverse lever in usual running position the lead of valves operated by the Stephenson motion is considerably greater than with the Walschaerts, which is constant for all positions of the reverse lever, and with the Stephenson motion compression in the cylinders is greater. The wear on the driving box brasses is found to be less with the Walschaerts motion.

NON-LIFTING INJECTOR.

(41) F. B., Philadelphia, Pa., writes: I have been interested in reading of the Phillips boiler check, as shown in your 2-8-0 chart, which we all here like so much. This check is on top of the boiler back of the smoke stack, and water delivered through it has to reach a point away above the level of the water in the tank. If any injector will put water into a boiler with this check why are some injectors called non-lifting?—A. The term non-lifting refers to the kind of injector. A non-lifting injector is one which does not lift water up to its own level. Water flows to it from the tank by gravity but it delivers the water to the boiler without reference to the position of the check. A lifting injector is usually placed higher than the average water level in the tank, and it draws up or lifts the water to its own height before delivering it. The lifting injector has an extra nozzle inside it, which does the lifting, and another one to do the delivering. The non-lifting injector has just one nozzle, and that is for delivering the water, which flows to it by gravity.

A German professor has made the "discovery" that machinery belts sometimes become so highly charged with electricity that they give off sparks that may ignite a dust laden atmosphere and cause what are known as dust explosions. Very few observing persons employed in shops and factories where heavy belting is used have failed to notice the sparking. To touch an electrically charged belt gives very striking evidence of its dangerous probability on an explosive mixture.

Celebrated Engineers.

VII. James Watt.

If the eighteenth century had not produced anything else to add to the sum of human achievement besides the steam engine that would be sufficient to mark it as a memorable epoch for all time. James Watt, the inventor of the modern steam engine, was born at Greenock, Scotland, in 1736. He became an expert as a philosophical instrument maker at an early age. He had found his way to London and returned to Scotland at the age of twenty and tried to establish himself as an instrument maker in Glasgow. A city guild of mechanics refused to recognize him, not because he was a poor workman, but because his apprenticeship had not been of the usual length. Some of the professors of the Glasgow University had the fine sense to discern the rare merit of the young mechanic's work, and to the everlasting glory of the University they invited young Watt to open a workshop within the University building. Here he remained for six years and had excellent opportunities for meeting many of the scientific men of his time. It was during this period that a model of Newcomen's atmospheric engine came into his hands to be repaired. It came into the hands of the right man. The transformation of the cumbrous pumping machine to the modern steam engine was not the work of a day nor the work of one man, but all the labors of all who had worked in the same department of human endeavor before him, as well as all who have come after, were as trifles compared to the marvelous changes in the machine of which Watt may justly be said to be the creator.

It will be remembered that Newcomen's engine consisted of a lever or beam supported in the middle. At one end of this beam was attached the rod of a piston capable of moving up and down in a cylinder after the manner of a common syringe. At the other end of the beam a pump rod sufficiently weighted to descend caused the other end to rise up, carrying the piston upwards in the cylinder. While the piston was rising steam was admitted under it, and when the piston arrived at the top, cold water was injected at the bottom, and the temperature of the steam being reduced, a vacuum was produced by the condensation of the steam. The pressure of the atmosphere forced the piston down in the cylinder, while the other end of the beam rose, bringing the pumping rod upwards, and by this operation the pumping of water from the mine or other work was carried on. There was, properly speaking, no steam pressure. The water was usually not boiling at all, the lid or boiler covering being left as often open as not. The purpose of using the jet of steam was in the production of the vacuum, so that the power of the engine came from the atmosphere rushing into the cylinder space made vacant by the condensation of the steam jet. This was the kind of engine a model of which came into Watt's hands in 1763.

It may be noted that previous to this Watt had been experimenting with steam, making many decisive tests of the elasticity of steam. Among these he found that a cubic inch of water will form a cubic foot of steam, with a pressure equal to the atmosphere. He also discovered the remarkable phenomenon that when a cubic foot of steam is condensed by injecting cold water, as much heat is given out as would raise six cubic inches of water to the boiling point. He also discovered that the latent heat of steam decreases as the sensible heat increases, and that universally these two added together made a constant quantity, which is the same for all temperatures.

JAMES WATT.

It appears that Watt's first thoughts on the steam engine were in the direction of traveling carriages, but Newcomen's engine coming into his hands set his mind in the direction of the stationary steam engine. He experimented for several years and finally conceived the idea of condensing the steam in a separate vessel, keeping the cylinder at a constant degree of heat. It was only after working step by step slowly, but most effectually, that the new creation began to assume form in the mind of the master mechanician. The condensation of steam in a separate vessel, the use of a constant vacuum, caused by a pump attached to the beam, the covering up of both ends of the cylinder, the admission of steam at a higher pressure regulated by the strength of the boiler materials, the invention of the slide valve, the invention of the governor, the use of the connecting rod and crank, and the use of the flywheel, the invention of the indicator, together with the adaptation of pressure gauges—these are some of the new features which marked the appearance of the new engine, which was shortly to become the most powerful, the most regular, and, unquestionably, the most ingenious ever invented by man.

Watt's engine was the visible accomplishment of the dreams of Worcester, the visions of Papin, and the wild theories of Savary. Watt himself was a dreamer, as all great thinkers are, but his dreams came true. His fame as an engineer spread rapidly, and by the time he was thirty years of age, he was easily the most noted engineer of his day. He entered into several important enterprises, the most notable being that of the establishment of the firm of Watt and Boulton. As constructors of Watt's engines they may be said not only to have created a new industry, but they created new conditions in the entire industrial world.

Coincident with his invention of the steam engine he made many other important improvements in mechanism, many of which are lost sight of in the light of the surpassing importance of his great master stroke—the steam engine, which grew into favor with amazing rapidity, and although the inventor was as usual not free from the annoyances of unscrupulous or jealous imitators, Watt was singularly fortunate in his undertakings, and in his later years honors came thick upon him. He could hardly have realized the means that his mighty engine has become in multiplying the resources of humanity, in annihilating time and space, in giving the feeble hands of man the strength of a Titan. Thirty years after the appearance of his engine, the locomotive, the steamboat, and the steam hammer came into being—all driven by his engine. The twentieth century has seen a new adaptation in a realm of which he could not have dreamed, in the adaptation of his mighty machine to transform the invisible elements of the earth and air into that mysterious force called electricity, and as the ages roll on doubtless newer and wider realms will open to the use of the steam engine of James Watt.

Few great men have had such warm eulogiums passed upon them as James Watt has had. His steam engine was unquestionably the crowning invention of all the ages, and in comparison with the gifted and the good of every land he was the world's greatest benefactor.

Rock Island 2-8-0.

The accompanying halftone is an illustration of one of 30 Consolidation type locomotives recently built by the American Locomotive Company for the Chicago, Rock Island & Pacific Railway. These engines have a total weight in working order of 204,500 lbs., 183,000 lbs. of which is carried on the driving-wheels. The cylinders are 23 ins. in diameter by 30 ins. stroke, driving wheels 63 ins., and with a working pressure of 185 lbs. These engines have a maximum tractive power of 39,610 lbs. The ratio of adhesion is 4.6.

They are intended for heavy freight service, and although, except for the application and use of the Allfree design of valves and cylinders to ten engines of this order, they have no very special features of design, but are excellent examples of modern heavy freight power.

The valves, as will be seen from the engraving of the side elevation of the engine, are actuated by the Walschaerts valve gear. In this instance the link bracket is attached directly to the back of the guide yoke, and the reversing shaft bearing is integral with the link bracket. The reach rod, which is made of 2-in. heavy iron pipe, is connected to a downward extending arm of the reversing shaft, and the radius-bar is connected by means of a lifting link to a backward extending arm of the shaft. Our illustration shows that grease cups have been applied to the front and back bearings of the eccentric rod, and the direct lubrication of these parts will no doubt considerably lessen the wear.

Although by no means the heaviest consolidation engines built, these are the largest locomotives of this type which have been supplied to the Rock Island road by the American Locomotive Company. The total wheel base of this engine is 26 ft., that of the driving wheels is 17 ft., and with the tender the total wheel base is 58 ft. long. The engine truck is of the swing bolster type with three-point suspension links. The frames, which are of cast steel with double front rails double bolted and keyed to the main frames, are 5 ins. wide.

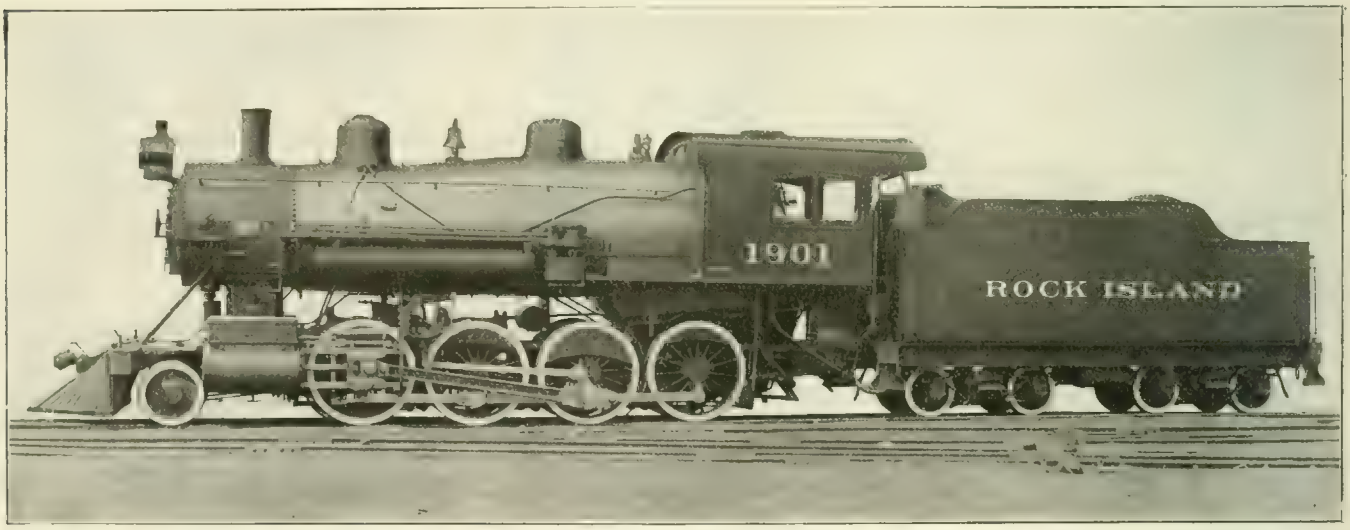
The boiler is of the extended wagon top type and has an outside diameter at the first ring of 74 ins. The tubes, of which there are 340, are 2 ins. in diameter and 15 ft. 6 ins. long, and have a heating surface of 2,743 square feet. The firebox, which is 107 ins. long by 67¼ ins. wide, with sloping back head and throat sheet, has a heating surface of 167.8 sq. ft., which gives a total heating surface of 2,910.8 sq. ft. The grate area is 51 sq. ft., which gives a ratio of grate area to heating surface of about 1 to 57, which combined with a ratio between heating surface and cylinder volume of 202 would indicate that these engines should have excellent steaming qualities. The arrangement and number of tubes gives a spacing of 1 in. between the tubes in this design, and promotes free water circulation.

The increase in the diameter of the cylinders of these engines, when compared with a previous lot built by the same company, permits of a reduction of boiler pressure from 200 lbs. to 185 lbs. in these latter engines, but the increase in the diameter of the cylinders, in the design here illustrated, more than makes up for the decrease in working pressure, and thus gives these engines the maximum tractive power quoted above.

The tank is mounted on an ordinary structural steel frame composed of 13-in. channels. The water capacity is, with the water bottom of the tank, 7,000 gallons, and 15 tons of coal is carried. Arch-bar trucks and solid rolled steel wheels are used.

The general dimensions are given below:

Weight—In working order, engine and tender, 357,300 lbs.
Axles—Driving journals, main, 10 x 12 ins.; others, 9 x 12 ins.; engine truck journals, diameter, 6 ins.; length, 12 ins.; tender truck journals, diameter, 5½ ins.; length, 10 ins.
Boiler—Working pressure, 185 lbs.; fuel, soft coal.
Firebox—Type, wide; length, 107 ins.; width, 67¼ ins.; thickness of crown, ⅜ in.; tube, ⅝ in.; sides, ⅜ in.; back, ⅜ in.; water space, front, 5 ins.; sides, 5 ins.; back, 5 ins.
Crown Staying—Radial.
Tubes—No. 11 B. W. G.
Boxes—Driving-boxes cast steel.
Brake—Pump, No. 6 N. Y., 2 reservoirs, 18½ x 126 ins.
Piston—Rod diameter, 4 ins.; piston packing, snap ring.
Smoke Stack—Diameter, 14½ and 16¾ ins.; top above rail, 15 ft. 7½ ins.
Wheels—Driving, material, cast steel; engine truck, diameter, 36 ins.; kind.; Std. Steel Works solid steel plate.



CONSOLIDATION ENGINE FOR THE ROCK ISLAND LINES.

W. A. Nettleton, Gen. Supt. Motive Power. American Loco. Co., Builders.

Shortsighted Inventors.

It is reported that a native of New Jersey built a new and improved threshing machine, using his cellar for a workshop. His ideas kept expanding with the progress of the apparatus until the invention assumed such proportions that the inventor has met the alternative of moving the house to get out the threshing machine or tearing the machine apart to make it pass through the doors of the house.

The predicament of another New Jersey man who become a mechanical engineer for a railroad company and proceeded to design a locomotive which had several new and original features. When the engine was built it was found that the engine had to be jacked up in order to make the side rods reach the crank pins. One thing it is well for an inventor to bear in mind and that is that some things which are mechanically possible fail because they involve too much outside adjustment.

Air Brake Department

Care of the Air Pump.

In fast passenger service an air pump failure is an engine failure, just as much as any part of the running gear and why the pump should not be given as much care and attention as any other part of the locomotive is not quite clear. The air pump is practically an engine in itself, even if it is not accorded the treatment of one, and, because it seldom gives any trouble in service, it is given comparatively little attention.

Like any piece of machinery it will wear out at some time, and if there is no specified time for it to be removed from the engine for inspection and repairs, it is quite likely to result in an engine failure, as it is unreasonable to expect the pump to break down while the engine ist standing in the roundhouse. It is more likely to break down shortly after pumping up the brake pipe pressure on a train of cars.

While pumping air into a leaky brake pipe has a tendency to overheat the pump, nearly all of the actual damage which results in a pump failure is done at the engine house at the time the pump is started.

Nearly every hostler, shop hand or fireman knows how a pump should be started, but the way it actually is started is very often by opening the throttle wide, whether there is any air pressure in the main reservoir or not, and if the surge of water in the steam end of the pump does not break anything, the piston, after a few seconds, will throw the water of condensation out through the exhaust pipe.

If this same action took place in the cylinders of a locomotive in motion it would probably knock out a cylinder head, but as there is no pressure on the pump piston, other than boiler pressure transmitted through the water, it cannot knock the top head off. The worst it can do is to wash out all the lubrication of the top head and throw a strain on the bolts holding it, which usually results in a leaky top head gasket, and this robs the pump of the small quantity of oil that can be spared from the lubricator.

When a high air pressure is reached the discharge valves do not lift until the piston is very near the end of its stroke. The stroke shortens somewhat, as the high air pressure checks the piston speed, thus giving more time for the reversing gear to operate. In order to be efficient the pump must deliver all the compressed air possible on each stroke. If it does not do this the compressed air that is not delivered to the main reservoir will expand in the cylinder and occupy space that should be filled through the receiving valves. It seems clear that if the stroke shortens after a certain pressure is reached in the main reservoir there must have been practically no clearance in the air cylinder while the air pressure was low. When the pump is started up fast with no pressure for the piston to cushion on, it must strike the heads in order to stop its movement.

NATIVES AT WORK ON THE PERMANENT WAY OF THE OTAVI RAILWAY, SOUTH-WEST AFRICA.

When a nut is rusted on a bolt or drawn so tight that it cannot be loosened with a wrench a hammer is generally used to pound the nut in order to loosen it, and when a pump is started in the manner described there is no reason why the pound of the main piston against the cylinder heads should not loosen the nuts on the bottom of the rod, and reversing plate bolts. If the end of the rod is burred so the nuts cannot work off, the piston will be loosened in the air cylinder. It may not occur the first or the second time the pump is started in this way, but it will eventually loosen, and the steel rod will soon cut its way through the cast iron head.

The use of the oil cock and strainer are pretty well known, but there seems to be an impression prevailing in some quarters that the oil cock is an ornament, and that the strainer is intended to distribute about a pint of engine oil evenly about the inner walls of the air cylinder when the pump is groaning. There are several styles of oil cups used on air cylinders of pumps, some with an adjustable feed and some with a fixed feed The former may be fairly well adjusted to feed the required amount of oil, but the cup with a fixed feed is very unsatisfactory, as the air cylinder of a pump in good condition requires very little oil, while a pump that is pretty well worn requires considerably more. As a result of this the cup with the fixed feed partly stops up the ports in the air cylinder of the pump which is in good condition, and does not feed enough to the average pump to keep it from groaning. The piston rod should have a swab, and when the pump is oiled the swab should be oiled. The swab will prevent dirt and ashes from cutting and wearing the rod, and by lubricating the rod packing the swab will save several dollars' worth of packing on each pump in course of a year.

Suggestions are quite frequently offered on how to avoid pump failures. They generally have reference to the construction of the pump; more and heavier reversing plate bolts, stronger

valve rods, and a wider shoulder on the main rod above the air piston being among the improvements suggested. If an air pump is used as the manufacturer intended it should be it will run several years without any repairs whatever, therefore if there exists any trouble from air pump failures it must be due to a lack of care and maintenance rather than to construction.

If the pump is run at an excessive rate of speed about the first disorder

ANGLE COCK DEVICE. VALVE OPEN.

will be an overheated pump. This is very expensive. It not only reduces the capacity of the pump by causing the packing rings and valves to leak, but scatters hot and burnt oil throughout the entire air brake system unless the main reservoirs are very large with a good piping arrangement.

When once hot the pump should be run as slowly as possible and kept oiled. Cooling the air cylinder with water is bad practice, as the cylinder is not of the same thickness all the way round and the temperature will reduce unevenly and likely warp the cylinder, which would necessitate reboring before new packing rings could be fitted, or it may result in the cylinder having to be thrown on the scrap pile.

The friction encountered in forcing the particles of air together generates the natural heat of compression, and as the piston passes the end of the stroke the cool air rushing through the receiving valve tends to dissipate the heat generated on the previous stroke, and from this alternately heating and cooling process it will be seen that a leaky discharge valve will assist materially in overheating a pump, although the common cause of heating is the additional friction encountered in forcing the compressed air through a discharge valve with too little lift or through restricted air passages.

A 9½-in. air pump can be run at such a high piston speed that the lift of the receiving valves will not allow the cylinder to be filled with air on each stroke. The partial vacuum thus caused in the cylinder reduces its capacity each stroke.

When the speed of the pump cannot be governed by instruction or discipline, or regulated by common sense, a copper gasket with a reduced opening placed in the steam pipe will prevent an unnecessary number of strokes per minute. Leaky air piston rings allow but a small volume of cool air to flow into the cylinder, and the "churning" of air is one of the common causes of a hot pump.

A blow through the steam end of the pump can develop at a number of places. About the only ones that can be heard on the locomotive are the top head gasket, the steam piston packing rings and a leak on the seat of the main slide valve. Leaks past the main valve packing rings, the reversing valve seat, and past the bushings usually stop the pump. It can then be started by tapping it lightly, and if the feed of oil is increased the pump may not stop again for several hours. When a blow is heard coming from the steam end of the pump it should immediately be given attention.

If a pump starts to pound after it has been in service any length of time, and is known to be well lubricated, tight on the bracket and the bracket tight on the boiler, the pound usually comes from an improper lift of air valves, loose main pistons or lost motion in the reversing gear, and should be corrected at once or the pound will result in an air pump failure. When the pump is neglected until it does break down in service very little can be done by the engineer in an attempt to repair it. Cases have occurred where the nuts on the rod worked off in the air cylinder and were replaced while on the road, and where a bent reversing valve rod has been removed and straightened, but the nuts were not put on properly in the first place, and if the valve rod is a neat fit through the reversing valve bushing it cannot be removed without taking off the top head because the plate hammers a shoulder on the rod in a short time after it is put in, and if a fit at the time the burr prevents the valve rod from being pulled out. The burr can be avoided by filing the edge of the rod where the plate strikes it, but the repairman does not suppose that an attempt will be made to remove the rod when the engine is out on the road.

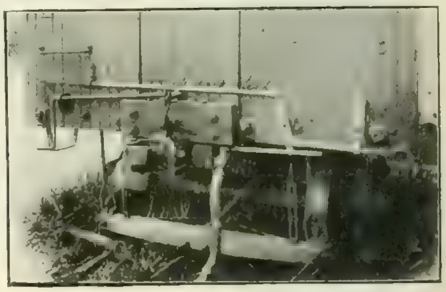
Sometimes a broken pump will make a stroke in both directions and stop at the bottom end, and if the steam is shut off and the reversing valve allowed to drop to its lower position, and the steam is again turned on, the pump will make another double stroke and stop at the bottom end.

If there is pressure in the main reservoir and the pump stops with a pound, it is usually due to a nut having worked off the rod in the air cylinder and blocked the main piston; if no pound can be detected it indicates a broken valve rod or a loose reversing plate. If the pump stops at the end of the up stroke with a pound it is usually due to a reversing plate bolt having worked out, although a piece of a broken air valve, or its seat blocking the air poston, will have the same effect. If the pump stops on the up stroke without any noticeable pound the trouble is usually in the top head. When the pump stops on account of insufficient lubrication it stops on the up stroke, with the main valve resting against the cap at the large end, which would appear to be the proper place to tap the pump, if necessary, to again start it.

The pump may become "dry" when it is not being used, and the main valve may have stopped in the opposite position. Opening the drain cock in the lower end of the steam cylinder will show on which stroke the pump has stopped.

When a pump apparently in good condition is reported to be stopping out on the road, and is known to be getting dry steam, and that there are no leaks in the steam pipe, top head gasket or in the pump governor past the steam valve, which would waste oil through the drain pipe, it is good policy to replace the top head of the pump with one known to be in good condition.

When the head is renewed under these conditions, the packing rings in the air cylinder should first be tested



ANGLE COCK DEVICE. VALVE SHUT.

by running the pump against an air pressure with the bottom cylinder head removed. The air valves should be examined and cleaned and the packing rings in the steam cylinder tested after the top head has been removed.

This can also be done in case the pump is due to be removed for inspection and repairs and if there happens to be no pump to replace it. In addition to removing the top head to inspect the gasket and reversing plate, particular attention should be given to the thickness of and the opening at the ends of the main valve packing rings; also to the wearing surface of the slide valve and its seat and to the reversing valve and bushing. Intelligent care of the air pump is often the means of avoiding an engine failure.

Electrical Department

Direct Current Motors.

Any direct current generator, if supplied with the proper voltage and current, will operate as a motor. This is due to the shove produced by the fields of the machine upon the wires or inductors of the armature which are carrying the current. If the generator is a shunt wound machine and its positive brush connected to the positive terminal of the supply, it will run in the same direction as that it was driven as a generator. If the generator is a series wound machine and its positive brush connected to the positive terminal of the supply, it will run in the opposite direction from that in which it was driven as a generator. Reversing the direction of the current supply to a motor will not change the direction of rotation of the motor. Either the connections of the field coils must be reversed with respect to those of the armature, or those of the armature must be reversed.

In reversing the direction of the supply, the direction of the currents in both armature and field coils are reversed, and the action of this double reversal is to cause the motor to rotate in the same direction as before. But when only the field connections or only the armature connections are reversed, the single reversal causes the motor to rotate in the opposite direction. This is true of both shunt and series motors.

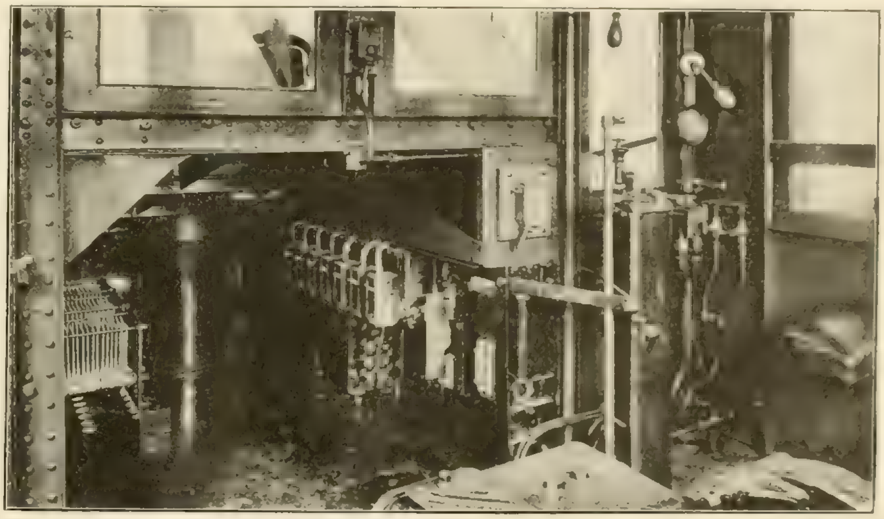
A motor increases the current input through its armature as the load on the pulley of the motor is increased. If no load is placed upon the pulley, that is, when the motor is running light, it will take only a very small current. For example, a certain 10 H. P., 110-volt shunt motor takes 9 amperes running light, 4 through the field and 5 through the armature. The armature resistance is one-half on ohm. The ohm is the unit of current resistance. According to Ohm's rule, it should take 220 amperes through its armature. The small actual current consumption of this motor is due to the back voltage of the motor.

This back voltage, or counter electro motive force, as it is called, is generated in the wires on the armature. Every wire or inductor on the armature of the motor as it revolves between the poles has a voltage or electro motive force generated in it. The direction of this induced voltage is opposite to that of the voltage supplied to the motor and tends to oppose it. The difference between the terminal voltage and the back voltage is the voltage that is effective in shoving current through the armature.

Now as the load on the pulley of a motor is increased, the motor will slow up slightly and this will reduce the number of revolutions per second and the counter E. M. F. will be lessened, thus allowing more current to pass through the armature and the motor to maintain the increased load. If anything should happen to open the field connections of a motor, it would run away or race, because the magnetism of the fields would fall to a very low value and the speed would have to become correspondingly high, due to the effort of the motor to maintain its back voltage.

In a series wound motor the same current that passes through the armature passes through the field coils, and when the load is reduced the motor increases its speed. This increase of speed raises the back voltage and cuts down the armature current. Reducing the armature current lowers the field current, this makes a further rise of speed necessary to maintain the counter voltage, with another corresponding cut in armature current. These act or conspire together to raise the speed and if not checked by cutting off the current will increase to such a speed that the centrifugal force will damage the armature.

This is why it is that in a shop motor of the series wound type a sudden removal of the load, as when a heavy cut in a lathe or planer comes to an end, the motor would race if the current was left on full strength.



INTERIOR OF AN ELECTRIC LOCOMOTIVE CAB.

When the armature of a motor is at rest there is no counter electro motive force, and a current destructive to the motor would flow through the armature, unless some form of starting resistance be inserted in circuit. As the speed of the motor increases the resistance can be gradually reduced without allowing the current to rise to too high a value, and when at almost full speed the resistance must be cut out entirely to avoid loss.

This is the reason for the resistance coils or rheostats which are used on electric motor cars. The various notches or points through which the handle of the motorman's controller is advanced cut out the resistance step by step and prevent a great rush of current through the armature.

Among electricians, torque is a word used to indicate the pull in pounds which the motor is able to exert. It is, however, restricted to certain conditions which may be explained by supposing a cable to be wound on a drum 2 ft. in diameter, and this drum turned by a motor placed on the shaft. Under such conditions the pull on the cable in pounds is the torque of the motor. If the pull on the cable is say 330 lbs. and the speed at which the cable is pulled up is 100 ft. a minute, then the motor would be exerting 33,000 foot pounds per minute or one horsepower. Even if the pull on the cable was not able to raise the weight at all the torque would be there, although no power would then be developed because

torque signifies the ability of the motor to produce a pull measured in pounds on a drum of 12 ins. radius. If the drum had a radius of 24 ins., or in other words, if the drum upon which the cable was wound was 4 ft. in diameter the torque would be the same, although the pull on the cable would only be 165 lbs., or half the former amount. Torque is always measured on a drum of 1 ft. radius, just as steam pressure is always measured in pounds to the square inch.

When it is desired to compare the torque of two motors operating drums, neither of them alike in size or having a radius of one foot, the comparison is made by first measuring the pulls at the circumferences of the existing drums. These two pulls are then reduced to the torque at a standard drum of one foot radius. When this is done the torque of the motors may be compared.

Suppose our motor has a torque of 330 lbs., this torque applied to a 4 ft. drum would give a cable pull of 165 lbs. If applied to a 6 in. drum would give a cable pull of 660 lbs. It is evident that in order to draw the cable up so as to exert one horsepower with the large 4 ft. drum the speed of cable would have to be 200 ft. per minute, and with the 6 in. drum it would only have to be 50 ft. per minute. Thus we see that with a given torque, power is proportional to speed, and at a given speed, power is proportional to torque. The torque produced by a motor is proportional to the current that flows through its armature. The speed at which this torque is developed is proportionate to the voltage supplied to the motor terminals. The product of the current and the voltage gives the power input to the motor. The product of the torque and the speed gives the power output of the motor. The power output divided by the input, multiplied by 100 gives the per cent. efficiency of the motor.

Some Forms of Batteries.

An earth cell, so called, may be formed by a sheet of copper and a sheet of zinc, both sheets being several square feet in area and set in damp earth a few inches apart. A wire attached to both metals and placed so that it will not touch the earth will convey a weak current of electricity, the force of the current depending on the size of the plates and the distance that they are apart from each other. The force thus created does not last very long. Several causes tend to make it of short duration. Disintegration of the plates sets in at once, but just as the decay of the metals begins they seem to possess the faculty of shielding themselves from the destructive action of the electric current and gradually cover themselves with a coating of hydrogen, which reduces the action of the current. Batteries of this kind have been used to operate clocks, and by changing the coated plates for clean ones, the battery could be kept in action for some time. Sea water cells have shown more durability than earth cells. The action of the sea washing off the coating gave better results than when the metals were laid in the earth.

One of the commonest experiments to produce a light current is by attaching a plate of carbon and a plate of zinc in a jar of salt and water, the proportion being about three times as much water as salt. The carbon and zinc are kept apart. The carbon rapidly covers itself with a film of hydrogen, which arrests the gradually weaking current. The carbon plate may be shaken into action again and the film of hydrogen is easily removed.

The most common form of cell is the Leclanché cell, so called from the name of the inventor. It was first shown in 1868 and is used in various forms, the most convenient form being that of a carbon plate surrounded by carbon dust and peroxide of manganese. These form what is called the negative element, the positive element being a rod or plate of zinc. They are placed in a glass or porcelain jar, the zinc and carbon being kept apart. The jar is filled with a solution of sal-ammoniac, one part, and water, four parts. The peroxide of manganese has the effect of depolarization, keeping the metal and carbon clear of hydrogen and the electric current continues uninterrupted until the exhaustion of the carbon, which can be readily replaced. This cell has the faculty of partly recovering its decreasing strength by disconnecting the wire joining the zinc and carbon and leaving it for some time in this condition. These cells, if kept clean, last very well. They are used in their simplest forms for ringing door bells. The solution is readily renewed as evaporation takes place.

There are many other forms of cells and other solutions may be used, an increase of strength being gained by the use of sulphuric acid in the water, the best mixture being about 30 per cent. of acid. Lead or silver plates platinized are used between two plates of zinc. This kind of cell is durable, the platinum preventing the accumulation of the hydrogenic film, but the strength of the current is not very largely increased.

Between the copper-zinc type of cells and the carbon-zinc type it may be stated that the latter class of cells are best suited for door bells and other light work where long periods of rest give time for recuperation. The copper-zinc variety are best suited for work where a small current is being constantly taken from them, and if large enough are suitable for running small motors, lamps or induction coils. Glass jars are preferable to eathenware, as minute cracks in the surface of ordinary eathenware soon weaken the cell. Many experiments have been made to harden the surface of the zinc used in electric work with a view to adding to its durability, and some success has been obtained in this direction, the result being that the best cells of to-day are much more durable than those made years ago.

Some Electrical Economies.

At the meeting last month of the New York Railroad Club, known to members as "Electric Night," Mr. W. J. Wilgus, consulting engineer of the Detroit River Tunnel Company, and formerly vice president of the New York Central, made some interesting remarks.

He said, among other things, the New York Central trains have been electrically operated between the Grand Central and Mott Haven, since last July. The system is considered successful from operating, engineering and financial standpoints; but more interesting is the knowledge that what may be termed the "by-products" are of much value.

With electric operation, it is possible to build offices over terminal yards. The New York Central property at the Grand Central terminal is worth very much more under electric operation than with steam operation, on account of the possibility of erecting revenue producing buildings on it.

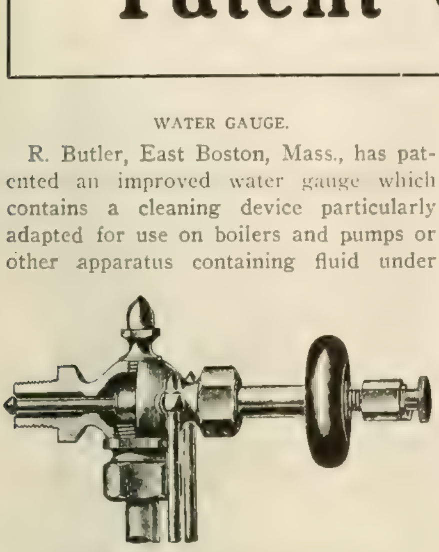
Under electric operation, also, money is saved in the lighting of yards and terminals. With the propulsion current always at hand it is easy to provide current for other purposes. There is also plenty of current available for labor-saving devices at freight terminals; for example, the operation of float bridges, unloading machinery, etc. A power house is always designed so that it is equal to handling peak loads. Between maximum requirements, power for other purposes can be turned out at an expenditure about equivalent to the cost of burning coal under the boilers.

Another advantage is the economy of switching by electricity. Also, when there is a continuous current-carrying conductor along the road, it is possible to use other devices, such as automatic stops. Automatic stops may take the place of surprise checking and so correct careless overrunning of stop signals.

Patent Office Department

WATER GAUGE.

R. Butler, East Boston, Mass., has patented an improved water gauge which contains a cleaning device particularly adapted for use on boilers and pumps or other apparatus containing fluid under



WATER MOUNTING. CLEANER IN.

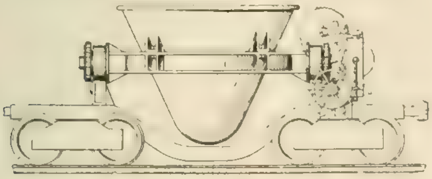
pressure. The device embraces a valve of the ordinary type, fitted with a cleaning rod passing through the valve stem and packing nut. The cleaning rod may be withdrawn and being hinged may hang outside the valve handle. To clear the passage all that is necessary is to straighten the cleaning rod and push through the passage, the cleaning rod being fitted with a conical head which fits in a recess in the valve. The cleaning rod is fitted with a milled head, and the rod can be operated while under pressure.

SPIKE PULLER.

An improved spike puller has been patented by J. D. Gillis, Eden, Maryland. No. 882,380. It comprises a bar having claws, a fulcrum member mounted on and disposed under the bar adjacent to the claws. There is means for guiding the member to slide longitudinally, and also an operating lever connected with the bar, and a connection between the lever and member for sliding the latter back and forth.

DUMPING CAR.

M. H. Treadwell, New York, N. Y., has patented a dumping car. No. 882,129.

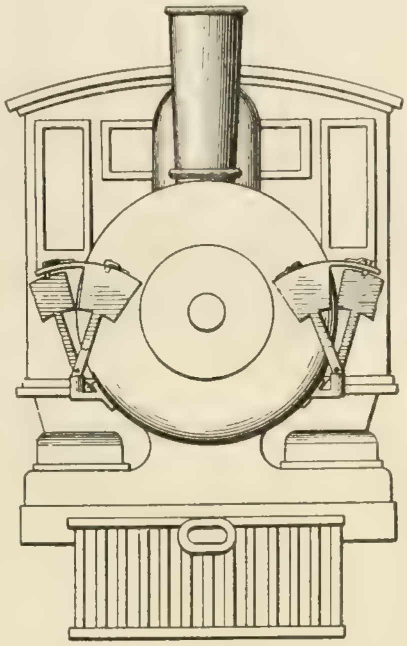


INDUSTRIAL RY. DUMP CAR.

It embraces a combination with a movable car body and manual means for moving it to discharging position. It also has fluid checking means for controlling the movement of the car body and moving with the power cylinder.

RAILWAY SIGNAL.

An invention relating to railway signals has been patented by Mr. W. N. Thompson, Tucson, Ariz., No. 877,385. As is shown in the accompanying illustration the device is mounted upon the

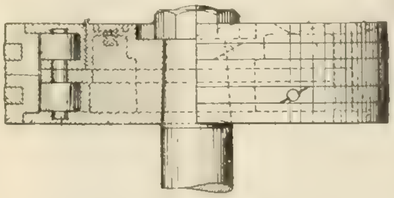


LOCOMOTIVE SIGNAL DEVICE.

forward part of a locomotive to take the place of flags or ordinary disks now provided for the purpose. There are a plurality of disks, signals or targets which differ in form and color, such as red squares or green crosses, the choice being entirely dependent upon the signal system in vogue. The signals may be mounted upon any part of the locomotive. The disks or signals are held in housings and are furnished with a curved guideway, the case receiving the signals when they are not in service.

PISTON.

K. Matheus and E. T. Hendee, Chicago, Ill., have patented a piston for steam en-

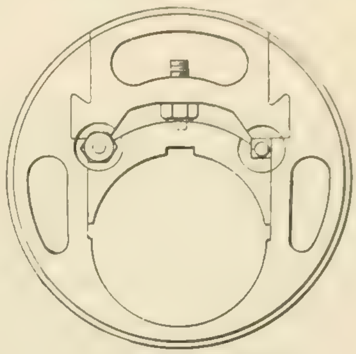


STEAM ENGINE PISTON.

gines. No. 882,572. The piston is equipped with a spider furnished with roller bearings and means affording a rotative wearing surface during the operation of the piston.

ECCENTRIC.

A skeleton eccentric for locomotives has been patented by G. M. Reid, Meridian, Mass. No. 882,537. It consists of a main section formed with a recess by which it is adapted to be slipped over a

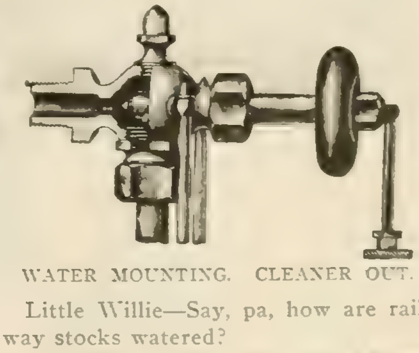


SKELETON ECCENTRIC.

shaft, a key designed to fit in the recess and complete the encircling of the shaft, the joint being formed at its outer corners with transversely extending shoulders, the side walls of the recess being formed with sockets. A fillet block closes the outer end of the recess and lugs project into the sockets with wedges interposed between the block and key. There are nuts screwing on the edges and overlapping the main section, the key and the block.

LOCOMOTIVE PILOT.

A locomotive pilot has been patented by Mr. H. J. Dean, Meadville, Pa., No. 871,789. It embraces a pilot-plate composed of two sections, adapted to be secured to the bumper-beam of a locomotive on each side of the draw-bar casting, a bottom frame suspended from the pilot plates, a nose piece secured in the front of the bottom frame and to the draw-bar casting, and slats secured to the pilot plates by means of ears on the upper ends thereof, and to the bottom frame by means of bolts or rivets.



WATER MOUNTING. CLEANER OUT.

Little Willie—Say, pa, how are railway stocks watered?

Pa—From a pool, my son.—Chicago *Daily News.*

Switcher with Brotan Boiler.

Our half-tone illustration Fig. 1 shows a novel design of shunting engine with the Brotan type of boiler and firebox. It has been built for the Mannesmann Tube Co., of Landore, South Wales, by Beyer Peacock & Co., of Manchester, Eng. The chief characteristic is the substitution of a series of water tubes for the usual inside firebox, with its attendant water space and stays. As will be seen from the reproduced photographs of the boiler, it consists of a main barrel containing fire tubes connected by two necks to an upper barrel. The under side of the rear portion of the upper barrel, or steam collector as some call it, is made of thick tube plate in which the water tubes are fixed. At the lower end the tubes are expanded into a rectangular steel circulating chamber, connected to the under side of the main barrel by a large pipe. The pipe is not shown, but the openings in chamber and barrel are visible in Fig. 2. The circulating chamber has on the under side a series of holes corresponding to the water ubes. These holes are there for the purpose of getting at and doing the work of expanding the tubes into the upper wall of the chamber. These lower holes are closed by plugs or doors which can be opened for repairs or inspection of the tubes and without removing the boiler from its frame. Fig. 2 shows one side group of tubes removed, which clearly illustrates the method of construction.

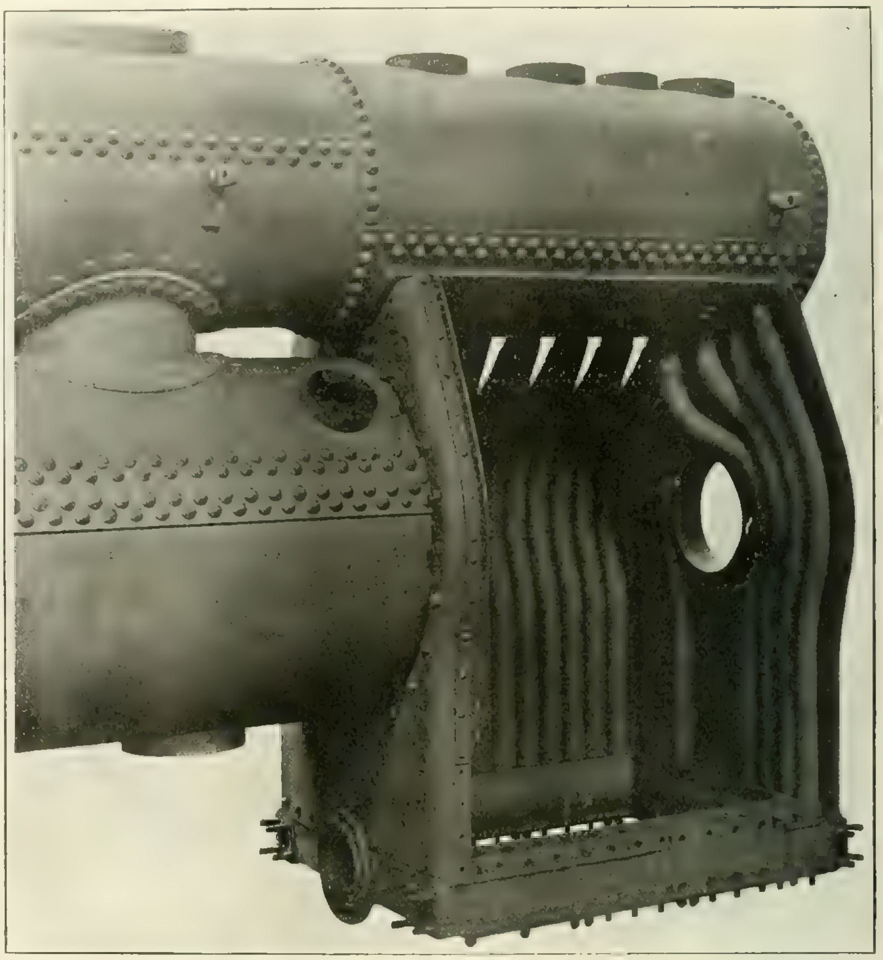


FIG. 2. BROTAN FIRE-BOX WITH ONE SET OF TUBES REMOVED.

As will be seen in Fig. 3, what may by courtesy be called the back sheet is a thin plate of steel, the firebox side plates are similar and the front of the box, outside of the actual tube sheet, is made in the same way. These light sheets are protected by fireclay or other resisting material. The upright tubes are placed as close together as possible and the walls of the firebox are therefore not sheets, but tubes.

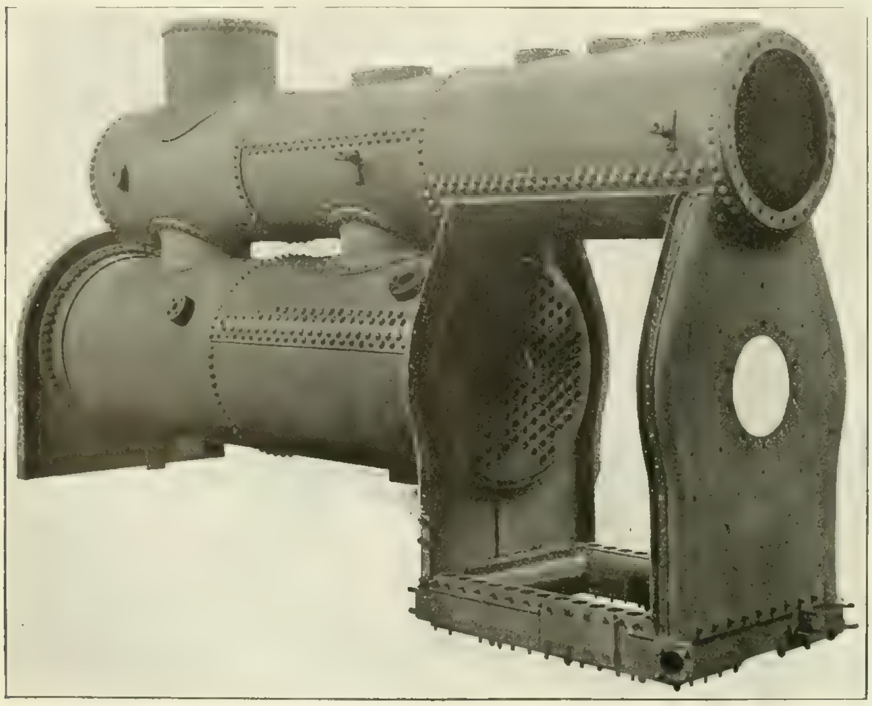


FIG. 3. BROTAN BOILER AND FIRE-BOX SHELL.

The water level is of course in the upper barrel, and this allows the lower barrel to be entirely filled with tubes, as shown in Fig. 3. The vertical arrangement of the water tubes in the firebox facilitates water circulation, and the elbow pipe leading from the under side of the lower barrel to the circulating chamber keeps this hollow "mud ring" always supplied. The tubes are very thin and are made of mild steel, without a weld.

These characteristics increase the efficiency of the heating surface very considerably, and the failure of one tube in the firebox would not cause a serious explosion. The firebox tubes are placed close side by side in the hollow "mud ring," if we may so call it, but they are made to enter the upper barrel in two rows of staggered holes. This is done so that the under side of the barrel, although reinforced by a thick plate, will not be too much cut away and weakened along one area.

Quick repairing is one of the claims made for this boiler, and first cost is said to be low. The same is also said to apply to maintenance charges. This form of boiler gives a larger heating

surface than the same size of boiler as ordinarily made would give, and the efficiency of the heating surface is higher. The engine presents a neat and compact appearance in its finished condition.

The cylinders are 14 ins. in diameter by 20-in. stroke, and the valve motion is actuated by the Walschaerts gear. The wheels are 3 ft. 1 in. diameter, and the weight in working order totals 30 tons 10 cwt. The tank carries 700 Imperial gallons of water. Altogether the engine is an interesting example of the effort to improve the steam engine.

The leading dimensions of the boiler are as follows:

FIG. 1. TANK ENGINE FITTED WITH THE BROTAN BOILER AND FIRE-BOX.

Main barrel, inside diameter	3 ft. 0¾ in.
Top barrel, inside diameter	2 ft. 3¼ ins.
Length between plates	9 ft. 6½ ins.
Number of fire tubes	153
Diameter of fire tubes	1¾ ins.
Number of water tubes	34
Diameter of water tubes	3¼ ins.
Firebox, length outside	4 ft. 3¼ ins.
Firebox, width outside	3 ft. 3 ins.
Working pressure	180 lbs.
Grate area	9.2 sq. ft.
Heating surface:	
Boiler	746 sq. ft.
Tubes	669 " "
Firebox	77 " "
Total	2,185 sq. ft.

Coal Burning Without Smoke.

At a recent meeting of the St. Louis Railway Club the subject was, "How to Burn Bituminous Coal in Boiler Furnaces Without Smoke." The paper read by Mr. L. P. Breckenridge, professor of mechanical engineering in the University of Illinois, is interesting to railroad men, especially that part of it in which the satisfactory, smokeless burning of coal is discussed.

Taking the world's yearly coal supply at 1,100,000,000 tons of 2,000 lbs. each, the United States contributes 400 millions, Great Britain 300 millions, Germany 200 millions and all the others 200 millions. Anthracite coal, produced almost exclusively in Pennsylvania, has increased but slightly in amount of output from that of twenty years ago, while the output of bituminous coal has rapidly increased, and at the present rate of increase will probably be about 600 millions in the United States in ten years.

The problem of smoke prevention is the problem of perfect combustion, and, the speaker said, it may be profitable to picture a case of ideally perfect combustion. The fuel is composed of carbon, various volatile hydro-carbon gases and perhaps sulphur. This is to be burned in the air. Theoretically each atom of fuel finds and seizes upon the exact num- of atoms of oxygen with which it will combine. Each atom will meet [illegible] oxygen atoms at a temperature sufficiently high for ignition. They will combine, and the resulting carbon di-oxide gas (CO_2) will pass out of the furnace, carrying with it the heat arising from the combustion. In like manner the hydrogen and sulphur atoms will combine with their required number of oxygen atoms. No more air will be delivered than is just sufficient to furnish the exact number of oxygen atoms, and no carbon or hydrogen atoms will pass out of the furnace without finding oxygen atoms with which they can combine. This is perfect combustion.

Actual conditions differs from ideal conditions in many respects. If only the theoretically necessary amount of air be supplied, some of the fuel atoms will not find oxygen atoms on account of the difficulty of properly mingling air and fuel, and some atoms will escape uncombined. Some of the carbon may only burn to Carbon mon-oxide (CO) instead of to carbon di-oxide, and this CO gas will escape further combustion. In practice an excess of air must be supplied. The excess is usually 50 per cent. and may reach 100 per cent. Only 11.3 lbs. of air are required for the complete combustion of 1 lb. of carbon; it is usually necessary to furnish 24 lbs. This extra air lowers the furnace temperature.

Carbon and oxygen atoms will not unite unless a certain temperature is reached. In parts of the furnace the temperature may fall below this ignition point on account of the inrush of an excess of air or from cold bounding surfaces. Carbon particles, even in the presence of plenty of oxygen may thus refuse to burn. If any fuel is to be burned without smoke, it must be supplied with the requisite amount of air. A torch smokes because the large round wick brings up oil, especially in the centre to which air cannot be supplied. If the air supply through the centre tube of a student lamp be shut off, a smoking flame results. The flame from a flat wick has an extended surface for air supply. If we try to increase the oil consumption by turning the wick up too high it smokes, and because the lamp is in our room we turn it down.

Furnaces burning coal sometimes smoke because they are forced too hard, and as the top of the chimney is not in our room, but is the air used by the public we do not turn them down—we let them smoke. Even when the smoke problem is well solved, the chimney discharges large quantities of heated gases, and these gases often carry with them fine particles of ash, all of which may produce something of that haze which floats over manufacturing cities.

For the public there are two kinds of chimneys, those that smoke and those that do not. The emission of black smoke for, say, three minutes in the hour, is enough to produce the impression on a casual observer that the chimney smokes all the time. If there is deficient air supply there will be a considerable part of the escaping gases leave the chimney as CO instead of being burned to CO_2. When this occurs there is approximately a loss of 10,000 heat units. This is the loss due to incomplete combustion. It may be 5 per cent. of the total heat in the coal. The density of the smoke may or may not indicate the proportion, though this loss in perfectly smokeless chimney gases in practice will usually not exceed 0.05 of 1 per cent.

Smokelessness is a relatively safe indication that the total heat has been liberated, but it unfortunately gives no indication of the degree of efficiency with which the heat is being utilized. The problem from the standpoint of the operator demands smokelessness with minimum air supply. Losses due to sensible heat in the stack gases, while seldom rising higher than 32 per cent. of the total heat, may be as low as 10 to 12 per cent. without smoke or incomplete combustion.

We are informed that Falls Hollow Staybolt iron has been specified for use in thirty engines now being built by the American Locomotive Company for the Paris-Orleans Railway of France.

Natural Racing Speeds.

The amazing speed attained in certain automobile races has made very little permanent impression upon people who display interest in the racing qualities of machines and of animals. The automobile which attains a speed of 120 miles an hour or the locomotive that reaches a velocity of 100 miles an hour make little more impression upon the popular mind than the speed of a projectile or of the heavenly bodies or of light or sound. People interested in promoting railroad interests frequently make systematic boasting of the speed maintained by certain trains and the advertising agents of certain steamboat lines persistently dilate upon the great speed achieved by certain passenger carrying vessels, but the details do not impress the popular emotions. Speed produced by power of steam or any other artificial means creates very little admiration. It does not appeal to the sporting instincts of mankind.

MACHINE SHOP AT ELKHART, IND., DESTROYED BY FIRE. L. S. & M. S.

Some lovers of horses feared for a time when automobile racing began that the machine would beat the horse not only in speed but in popular favor. That has not happened, and automobile racing wanes while horse racing grows in popularity. The racing of men and of the lower animals has always been highly popular even from the earliest times, before people had to excuse the "vice" of horse racing on the pretence that it led to improvement in the breed of horses. Very few people remember details of the highest speed reached by the latest automobile racers or the quickest mile made by the fastest railroad train or transatlantic steamer, but thousands remember that in 1877 Ten Broekk broke the horse racing record by running a mile in 1.39¾, which was reduced in 1890 by Salvator to 1.35½.

Ordinary speed for a man walking is four miles an hour, but fast walkers can cover five miles in the same time. Professionals have lowered the walking record considerably. In 1870 Dan Stern of the New York Athletic Club broke all previous performances by walking a mile in seven minutes, a little over eight and a half miles an hour. Good swimmers make about two miles an hour, oarsmen in an eight-oared barge pull about ten miles an hour, skaters go about twenty miles an hour when at the fastest effort.

The horse can keep galloping six miles an hour for a considerable length of time. The swiftest dog in the world, the borzoi, or Russian wolf-hound, has made record runs that show 75 ft. a second, while the gazelle has shown measured speed of more than 80 ft. a second, which would sum up to 4,800 ft. a minute, if she had the necessary endurance.

The gazelle, swift as she is, cannot equal the ostrich, for that homely but swift bird can run 94 ft. to the second when he really gets down to it. He is somewhat helped by his wings.

The whale, struck by a harpoon, and scudding in terror, has been known to dive 330 ft. in a minute. In the air we have the Virginia rainpiper covering 7,500 yds. a minute and the European swallow 8,000 yds.

The slowest creatures are snails and certain small beetles. Some of them habitually move only a foot or two an hour. But part of the slowness is due to the fact that they remain motionless at intervals. A good, healthy snail, when kept going, does about 5 ft. an hour.

It does not matter what other people think of you, of your plans, or of your aims. No matter if they call you a visionary, a crank, or a dreamer, you must believe in yourself. If you forsake yourself by losing your confidence, you can accomplish nothing.

Items of Personal Interest

Mr. J. H. Sanford has been appointed purchasing agent on the New York, New Haven & Hartford, vice Mr. A. E. Mitchell, resigned.

Mr. F. R. Cooper has been appointed superintendent of motive power of the Kansas City Southern Railway, with headquarters at Pittsburgh, Kan.

Mr. W. E. Looney has been appointed general car foreman of the International & Great Northern Railway, with headquarters at Palestine, Tex.

Mr. F. T. Armistead has been appointed engineer of maintenance of way on the Tonopah & Goldfield Railroad, with headquarters at Tonopah, Nev.

Mr. M. T. Pratt, formerly superintendent of the Texas & Gulf, has been appointed division engineer of the Gulf, Colorado & Santa Fe, with offices at Beaumont, Tex.

The position of engine foreman on each of the three divisions of the Santa Fe in Texas has been consolidated and all are now under Mr. J. W. Walker, at Cleburne, Tex.

Mr. John T. Luscombe has been appointed division master mechanic of the Toledo & Ohio Central, with office at Bucyrus, Ohio, vice Mr. John B. Morgan, deceased.

The office of Mr. F. Tawse, superintendent of motive power of the Detroit, Toledo & Ironton and the Ann Arbor, has been removed from Jackson, O., to Toledo, O.

Mr. B. H. Bail has been appointed freight traffic manager of the Philadelphia & Reading Railway and allied lines, with headquarters at Reading Terminal, Philadelphia, Pa.

Mr. A. Fortin, formerly locomotive foreman on the Canadian Pacific Railway at Ottawa, Ont., has been appointed locomotive foreman on the same road at Quebec, Canada.

Mr. John E. Greiner, formerly assistant chief engineer on the Baltimore & Ohio, has resigned. He will open offices in Baltimore, Md., New York and Chicago as a consulting engineer.

Mr. F. J. Lass has been appointed mechanical inspector on the Central of Mexico Railway, with headquarters at Aguascalientes, Mexico, vice Mr. A. S. Williamson, assigned to other duties.

Mr. J. E. Dalrymple, formerly general freight aient of the Grand Trunk Railway, has been appointed freight traffic manager of the Grand Trunk Pacific, with headquarters at Winnipeg, Man.

Mr. R. L. MacFarland has been appointed erecting shop foreman on the Burlington, Cedar Rapids & Northern, with headquarters at Cedar Rapids, Ia., vice Mr. I. A. Moore, promoted.

Mr. John C. Sesser, engineer of maintenance of way of the Chicago, Burlington & Quincy at St. Louis, Mo., has resigned to become vice president of the W. K. Kelly Company, of Chicago.

Mr. A. S. Williamson has been appointed mechanical engineer on the Central of Mexico Railway, with headquarters at Aguascalientes, Mexico, vice Mr. F. J. Lass, assigned to other duties.

Mr. Hugo Schaefer has been appointed master mechanic of the Panhandle division of the Atchison, Topeka & Santa Fe Railway, at Wellington, Kan., vice Mr. O. A. Fisher, resigned.

Mr. A. B. Phillips has been appointed superintendent of motive power, in charge of machinery, shops and rolling stock equipment on the Tonopah & Goldfield Railroad, with headquarters at Tonopah, Nev.

Mr. T. Milne, formerly locomotive foreman on the Canadian Pacific Railway at London, Ont., has been appointed locomotive foreman on the same road at Windsor, Ont., vice Mr. W. H. Kirkby, transferred.

Mr. J. Scott, formerly general foreman of the locomotive shops of the Canadian Pacific Railway at Vancouver, B. C., has been appointed road foreman of locomotives on the same road, with headquarters at Souris, Man.

Mr. A. E. Mitchell, heretofore manager of purchasing and supplies on the New York, New Haven & Hartford, has resigned and is now connected with the Wyckoff Pipe & Creosoting Company, of New Haven, Conn.

Mr. Ira A. Moore, formerly erecting shop foreman on the Burlington, Cedar Rapids & Northern, has been appointed general foreman on the same road at Cedar Rapids, Ia. This road is now part of the Rock Island Lines.

Mr. D. R. MacBain, formerly assistant superintendent of motive power and equipment of the Michigan Central at Detroit, Mich., has been appointed assistant superintendent of motive power of the New York Central & Hudson River, with headquarters at New York.

Mr. J. W. Storey, mechanical engineer of the Cincinnati, New Orleans & Texas Pacific Railway, at Ludlow, Ky., has resigned to accept a similar position with the Central of Georgia Railway, with headquarters at Savannah, Ga.

Mr. G. F. Weiseckel, formerly foreman of the locomotive department of the Baltimore & Ohio at the Glenwood shops, Pittsburgh, Pa., has been appointed master mechanic of the Cumberland division on the same road, with headquarters at Cumberland, Md., vice Mr. A. H. Hodges, resigned.

Mr. G. Fred Collins, after some two years' absence representing some of our well known railroad supply people in Mexico, has returned to this country and has accepted a position with the Gold Car Heating & Lighting Company, with office in the Whitehall Building, 17 Battery place, New York City.

Mr. Albert R. Reece, formerly of the Chicago Junction Railroad, has been appointed engine house foreman on the Pennsylvania Railroad, with headquarters at Chicago, Ills., vice Mr. R. E. McCarthy, transferred. We stated in a former issue that Mr. Reece was stationed at Pittsburgh. He is, however, in Chicago.

Mr. F. W. Stanyan has been appointed general superintendent with full charge of maintenance, operating and traffic, on the Montpelier & Wells River Railroad, with office at Montpelier, Vt. Mr. Stanyan has been connected with the Montpelier & Wells River Railroad as superintendent since 1898, and also as treasurer since 1903.

Mr. M. M. Reynolds, formerly comptroller of the Mexican Railway, has been appointed fifth vice president of the Grand Trunk Railway, with headquarters at Montreal, Quebec. Mr. Reynolds has special supervision of the treasury and accounting departments, and has also general supervision of the financial matters of the corporations in which the company has a pecuniary interest.

The business of the Dressel Railway Lamp Works of New York having increased throughout the West, they have found it necessary to appoint a Western sales manager. Mr. Edward W. Hodgkins has been selected for this position and now has an office in the Western Union Building, Chicago. Mr. Hodgkins is well known in railroad circles and assumed the management of the Western sales department on May 1.

Mr. R. E. McCarthy, formerly engine house foreman on the Pennsylvania, has been appointed engine house foreman of the Pittsburgh, Cincinnati, Chicago & St. Louis Railroad at Chicago, Ills. We stated in a former issue that Mr. McCarthy was stationed at Pittsburgh. He is, however, located in Chicago.

Mr. Fred W. Cooke, Jr., seems to be a worthy successor to the name of one of our most successful locomotive builders. Fred is an apprentice in the Cooke Locomotive Works at Paterson and one of the second in succession from John Cooke, the founder of the works. The other day Fred met with an accident which resulted in two fingers of one hand having to be amputated. The young man displayed proper pluck, and remarking that he had six fingers and two thumbs in useful condition, he would go on working at the machinist business.

Much of Mr. Andrew Carnegie's early education bore the home stamp, his mother having been the teacher. Constitutionally Andrew is critical and his criticism of English spelling began as soon as he was able to read. To all the objections he raised to the stereotyped spelling his mother would remark: "Never mind what you think it ought to be, laddie. Follow the book rule and don't argue." The don't argue advice was followed by good results, but there is no saying that his readiness in old age to adopt the reformed spelling was not an echo of his boyhood predilections.

General Foremen's Association.

Now is the time to get ready for the coming convention of the International General Railway Foremen's Association, which is to be held in Chicago at the Lexington Hotel May 25 to 29 inclusive. The president, Mr. E. F. Fay, and Mr. C. H. Voges, chairman of the executive committee, are working hard to have the convention what it deserves to be, a huge success. The officers of the association wish to impress upon the members that it is "up to them" to get ready in time and to bring their wives and sweethearts with them when they come. The General Foremen's Association, with the assistance of the Supply Men's Association, have arranged a most enjoyable programme, and all members should be "among those present." Membership in this association is open to railway shop foremen, and if any one eligible for membership is desirous of joining, we will be glad to send him an application form, if he will write us to that effect. The General Foremen's Association is a body of live men and it is an organization useful alike to its members and to the railways they serve. Success can be attained by united effort, and with the convention in sight, now for a long pull, a strong pull and a pull all together.

Boiler Makers' Convention.

The following notice is given by Mr. George Wagstaff, president of the International Master Boiler Makers' Association, and is addressed to members and friends:

"An exceptional opportunity will be offered to members of the Association who attend the annual convention in Detroit, Mich., on May 26, 27, and 28, to travel via the Michigan Central Railroad. If a sufficient number elect to use this route from either Chicago or Buffalo they will do so with advantage as superior service and fares will undoubtedly be offered. It may be possible for all to travel together and obtain concessions that would not otherwise be available. Please advise the secretary at once whether you will attend the convention and whether you wish to be included in whatever arrangements are made."

The secretary of the association is Mr. Harry D. Vought, 62 Liberty street, New York City.

Obituary.

Orlando Stewart, formerly superintendent of motive power of the Bangor & Aroostook, died at his home in Brighton, Mass., on the 27th of April, aged 74 years. Mr. Stewart retired from railroad work last fall and has been in failing health for some time. He is mourned by a wide circle of friends and his death removes a veteran railroad man from the ranks.

It is with deep regret that we have to record the death of Hall Wilson Watts, master car builder of the Monongahela Connecting Railroad at Pittsburgh, Pa. Mr. Watts was at the time of his death President of the Pittsburgh Railway Club. The Railway, the club and a large circle of friends sincerely mourn his loss.

To the great regret not only of the whole staff of the Candian Pacific Railway, but of numerous friends all over the country, Charles Drinkwater, assistant to the president of the C. P. R., and for many years the secretary of the company, passed away on the 23rd of April. Mr. Drinkwater had been connected with the Canadian Pacific Railway ever since its inception, and was conversant with its every detail before the late Sir John Macdonald launched the project upon the young Dominion.

He was born at Ashton-under-Lyne, Lancashire, Eng., on Nov. 17, 1843. He entered railway service as a clerk on the Manchester. Sheffield & Lincolnshire Railway, in 1859, and was also for three years on the Great Northern Railway at London. In 1864 he came to Canada as the private secretary of Sir John Macdonald, who was for many years premier of Canada. Mr. Drinkwater served in this capacity up to 1874, and accompanied his chief to Washington during the sittings of the Joint High Commission that concluded the treaty of Washington in 1871. In 1874 he became chief assistant to the managing director of the Grand Trunk Railway, and in 1881, when the Canadian Pacific Railway was organized, he was chosen secretary of the company.

Air Brake Association.

We have received a communication from Mr. F. M. Nellis, secretary of the Air Brake Association in which he calls the attention of members to page 81-89 of the 1907 proceedings of the Associations. Members are requested to communicate with Mr. S. G. Down, 1545 Railway Exchange Building, Chicago, before May 10, if in their opinion any improvement can be made in the "recommended practice" of the Association. Mr. Nellis also states that "Mr. L. S. Hungerford, General Superintendent of the Pullman Company, Chicago, Ill., has granted a concession to members of The Air Brake Association in Pullman transportation. Each member in order to benefit from this concession, must secure a receipt for moneys paid by him at the local office, where he starts from, when buying his ticket. Upon presentation of this receipt, accompanied by his Association credentials at the close of the convention in St. Paul, he will receive a free sleeping car ticket returning home, thus giving him one-half rate for the round trip in Pullman cars. Agent's receipts only will be honored, and train conductor's coupons will not be accepted as heretofore.

Mr. Nellis continues, "We regret that that the question of railroad transportation has not improved since last year. All we can do is to suggest that members apply to their immediate officials, in the usual way, for transportation over their own lines and over other lines to reach the Convention.

"The managers of the Hotel Ryan, our Convention headquarters, suggest that members make room reservations as early as possible, as there are four other Conventions in the city during the same week, having headquarters elsewhere.

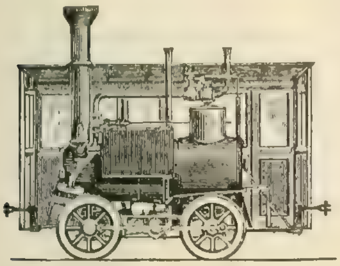
"The Union Depot Car Line passes the main entrance of our Convention headquarters in St. Paul.

"Only a few of our members have responded to the annual call for dues, and we take advantage of this occasion to advise that those who have not as yet sent in their dues, might now do so thus enabling us to reduce this amount of work which entails considerable confusion at the Convention."

Elevated Railways of New York.

BY GEO. H. JACKSON.

The first great step in the series of what constitutes the elevated railroads of New York City was started in the early seventies. It was thought by some engineers that an elevated structure with standard gauge was advisable and the work was started. The cars were to be run by an endless chain.



FIRST ENGINE FOR THE ELEVATED.

The road was originally built along Greenwich St. extending to 23rd St. and Ninth Ave.

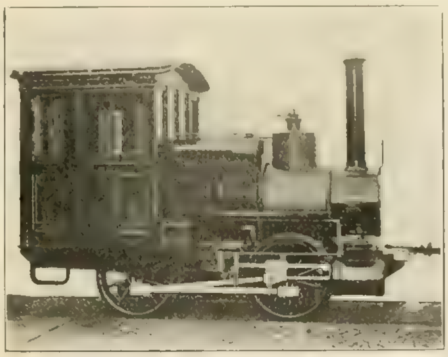
The resources of the first company being exhausted, the property lay idle for some time. A new company was then formed. The principal men were Messrs. Cyrus W. Field, who laid the first Atlantic cable; David Dowes, the "grand old man" of New York; and last, but not least, the late Samuel J. Tilden, he being Governor of the State of New York at that time. It was he who conceived the idea of having a special act passed, and under authority of this law the elevated system of New York City was built.

In order to demonstrate its feasibility a small force of railway men were brought together, the writer being one of them. A small locomotive was procured and hoisted onto the structure at the corner of Dye and Greenwich Sts., on the site of the Ocean Bank. This engine weighed about 6½ tons. The boiler was upright, resembling a modern steam fire engine. The cylinders were 8 ins. in diameter and 10-in. stroke, carrying 160 lbs. steam. The engine burned hard coal. The experiments, which were carried on for at least a year, proved so successful that an old horse car was procured for the use of passengers. Owing to the success of these ventures, larger engines and cars were ordered, and the road was extended to 34th St. and Ninth Ave. and the principal business was to carry passengers who arrived at the New York Central station at Tenth Ave and 34th St.

The writer well remembers how, on the 4th day of July, 1876, the day when Gen. Newton blew up Hell Gate, the road carried 10,000 passengers. The officials were so gratified with this success that the superintendent, T. T. Onderdonk; the engineers and conductors were invited to meet them at the residence of Cyrus W. Field, at 13 Gramercy Park. Mr. Tilden was present and the writer well remembers some remarks made by him.

Immediately after this event work was commenced on plans for the 3rd Ave. elevated road. The writer was a fireman on the first locomotive which ran up 3rd Ave. to 42nd St. All the important men of New York, including J. Gould, newspaper men and others, were the guests of the board of directors at a reception on the elevated station at 42nd St. and Park Ave., opposite the Grand Central Station on Aug. 17, 1878. There was a great rejoicing and manifestation of gratitude toward the promoters of this great work, which partly solved the great problem of rapid transit; for the writer remembers when it took an hour to go from the Battery to 23rd St. Electric lights and telephones were then unknown.

The directors about this time gave orders for 50 locomotives, which were



OLD TIME "ELEVATED" ENGINE.

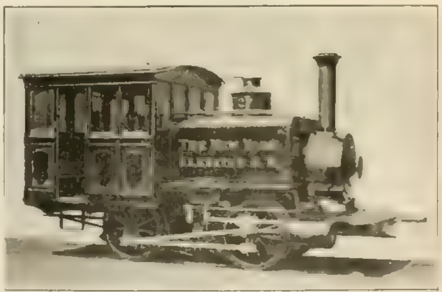
much larger and stronger. The cylinders of the new ones were 12x14 ins. The engines weighed approximately 30 tons. On Dec. 24, 1878, the road carried 100,000 passengers, and the board of directors at a meeting held at No. 7 Broadway were so gratified at their success that they ordered 50 more locomotives and 200 cars for immediate delivery.

During this time work was being pushed on the 6th Ave. road, which was at that time called the "Gilbert Elevated Railway." This road ran as far as 58th St. and Central Park. It was shortly afterward extended to 155th St. on the west side. The writer remembers seeing 40 engineers and firemen hired in one day. It was deemed advisable by the officials that steam railroad engineers and firemen were the best. They were paid according to their experience and ability on the surface locomotives. The earning capacity of these roads was so great that it was decided to merge them into one company, called the Manhattan Elevated Railway Company. This was done about 1880.

The writer was in New York some time since, and in calling the roll of men who started the great work he was able to account for only ten. The rest have passed away. I was informed while in New York by Mr. Frank Headley, who came to the road in 1880, that the average traffic on the roads at present is 800,000 people a day, and the Subway, which is operated by the same company, carries 500,000 people a day.

For the benefit of the younger generation, I am submitting with this article some pictures of locomotives which the pioneers of rapid transit in New York City had to deal with. These locomotives were built at the Baldwin Locomotive Works. The fire boxes were 3 ft. wide and 4 ft. long. The engines were run from 6 A. M. until 7:30 P. M., when employees returned home, there being no night service. The locomotives were left in charge of a hostler. The cars were built by Gibbert-Bush & Co., of Troy, N. Y. They were called "belly cars." They had stoves in each end.

I can recall an incident which occurred on the Ninth Ave. road in 1877. The engineer on engine No. 14 while going up Greenwich St. put on the brakes and stopped. The conductor came forward and inquired the reason for the stop. The engineer, who was used to running on a surface road, replied, "I saw a farmer with a load of hay ahead, and thinking he was about to cross the track I applied the brakes to give him an opportunity to do so." The engineer's name was George McLeary, and if I am not mistaken he is still alive. It was a common sight then to see a farmer with a load of loose hay driving through the streets. In those days the Ninth Ave. track ran on

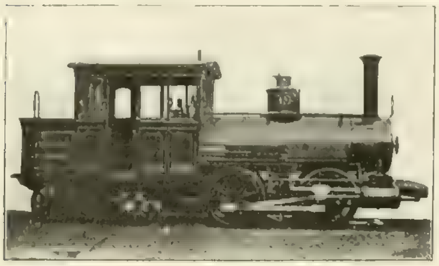


BALDWIN "ELEVATED" ENGINE.

the east side of Greenwich St., and I remember the trouble we used to have. We ran our trains on telegraphic orders. Occasionally there was a turnout to go in and allow the opposing trains to pass.

The company had a great deal of trouble with a gentleman named Patten. He owned an hotel which was

built and run by him in the early fifties. It [illegible] Greenwich St. above Cortlandt [illegible] spent a fortune in trying to [illegible] company from passing his hotel [illegible] side of the street, and strange to relate, he died the night before we ran the first train on the structure past his property. The traveling public was slow to appreciate the efforts in their behalf. I recall the lady



FORNEY TYPE ON THE MANHATTAN "L."

who made the first trip on this road, for the management made her a present of a silk dress.

We had no ticket agents at that time. The conductors collected the passengers' fares, as is customary on street cars today. The fare was 10 cents. I remember going to 59th St. and Central Park on a horse car along West St., with a little straw on the floor of the car to keep one's feet warm. The ride to 59th St. consumed one hour and fifteen minutes. I do not remember hearing of a passenger being hurt in the early days.

The writer, just before he left the service of the company, ran the first express train between 155th and Rector Sts. The late Col. F. K. Haine was at that time the general manager of the system, and to accommodate some of our wealthy patrons from Tarrytown, it was decided to run this express train. The running time between 155th and Rector Sts. was 29 minutes, the distance being 10.8 miles. I ran the train so fast they would not allow me to run it again.

I would like to tell of some of our trouble in the early days of rapid transit in New York for the benefit of those now enjoying the present splendid transit facilities. The first car operated had no power brakes and had to be stopped by hand. In the late seventies an air brake was invented which proved very satisfactory and was in service for a quarter of a century on this road. This brake differed widely from the present Westinghouse automatic brake. It had no automatic feature. It was known as an atmospheric brake. There was an ejector used, by which the air was exhausted from the train pipes. A diaphragm on the trucks to which the brake levers were attached, applied the brake. The brakes were released by letting air into pipes again. This brake was the Eames vacuum brake. It was cheap in construction and very easily maintained. The Westinghouse brake, which has taken the place of the old brake, has done more than any one agency to bring about the rapid transit that people are enjoying today. I have always considered this the greatest invention known to the traveling public of to-day.

Grand Trunk Steel Hopper Car.

Not long ago the Grand Trunk Railway of Canada purchased from the Pressed Steel Car Company of Pittsburgh a number of 100,000 lbs. high side steel hopper gondolas which we here illustrate.

The car is a standard all-steel hopper car, of which 500 were built on one order and 1,000 on another order for the Grand Trunk system. These cars are equipped with Westinghouse air brakes, Climax couplers, twin spring draft gear, arch-bar trucks with pressed steel bath-tub type of truck bolsters, and pressed steel brake beams.

The general dimensions are as follows: Length over end sills, 31 ft. 6 ins.; length of body inside, 30 ft. ¼ in.; width of body inside, 9 ft. 6 ins.; width over side stakes, 10 ft. 1½ ins.; height from rail to top of body, 10 ft.; length of drop doors in clear, 2 ft. 4½ ins.; width of drop doors in clear-top, 3 ft. 4 ins.; width of drop doors in clear-bottom, 3 ft. ⅞ in.; distance from center to center of trucks, 21 ft. 9 ins.; size of journals, 5½x10 ins.; light weight of car, 37,400 lbs.; cubic contents or volume, 1,918 cu. ft.

GRAND TRUNK 50-TON HIGH SIDE HOPPER BOTTOM STEEL GONDOLA.

Westinghouse Machine Company.

We have received the following notice from Mr. George Westinghouse, which we print with pleasure, not only because Mr. Westinghouse is an old and valued friend but because the notice is an indication of returning prosperity, which we hope to see extend all over the country.

"I have much pleasure in being able to notify the clients and other friends of the Westinghouse Machine Company that the receivers appointed October 23, 1907, by the Circuit Court of the United States for the Western District of Pennsylvania, were, on March 31, 1908, discharged by the same authority. All of the matters which made a temporary receivership expedient have been satisfactorily arranged and the company's position is greatly strengthened from every standpoint.

All contracts made by the receivers for the sale of the company's product or for the purchase of materials or merchandise will be carried out as though made by the company's own officers.

I take this occasion to announce the election of Mr. William H. Donner as the vice president of the company in direct responsible charge of all of its activities, and to give the assurance of the continuance and accentuation under Mr. Donner's administration of that steadfast policy whereby the clients of the Westinghouse Machine Company have become friends as well as customers."

Geo. Westinghouse,
President.

Wrecking Crane for the I. C. R.

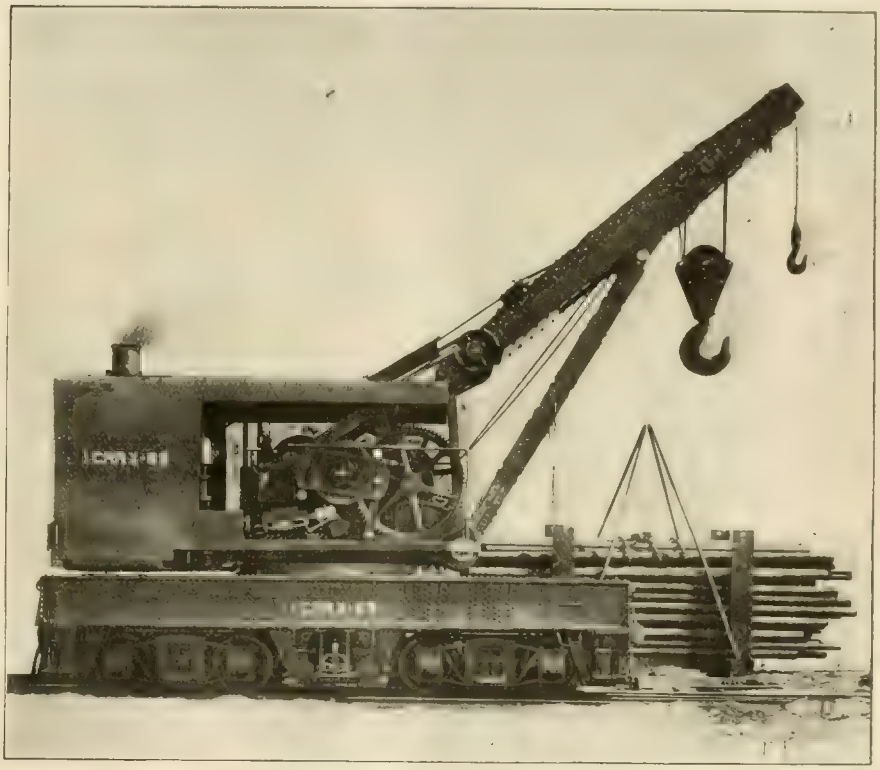
Our illustration shows a new railroad wrecking crane put upon the market by the Shaw Electric Crane Company, of Muskegon, Mich. One of these has just been bought by the Illinois Central. While the crane is of the same general type as other makes of wrecking cranes, many advantages are claimed in the way the design has been worked out.

An important feature is the location and position of the engines, which are the reverse of the usual position, the cylinders being placed toward the rear and well back, instead of toward the front of the crane. This makes the piping short and direct, keeping it away from the machinery and from the engineer's head.

The steam pipe branches at the throttle, and passes down at each side just in front of the coal bin and water tank, to the cylinders. The exhaust pipes pass back underneath and up to the separator on the back of the boiler, from which the exhaust steam passes through tubes inside the boiler to the stack. The pipes are thus entirely out of the way, and are not subjected to strains from shocks that may cause deflection or vibration to the part of the frame carrying the boiler.

In keeping all steam work to the rear of the engines it makes it possible to put the side frames farther apart and so keep the machinery low, resulting in a lower centre of gravity and giving the engineer a good view of his work, without placing him in a dangerous position. An improvement over past practice is the use of steam to apply the main and auxiliary hoist brakes in addition to the usual hand applying mechanism. The auxiliary hoist is unusually powerful, having a capacity of 20 tons on a single line, and 40 tons by the use of a one-sheave block.

The jib is also a departure from past practice. The new design avoids the combined bending and compression strains of the old type, and gives a lighter and stiffer structure, adding to the safety and stability of the crane. Unobstructed passage for the engineer to and from the cab has been provided on both sides of the machine. The engines have an improved Walschaerts valve gear, which gives smooth action at all speeds and is easily reversed under load.



WRECKING CRANE ON THE ILLINOIS CENTRAL

Some of the important features of the steam generating outfit are, forced draft, telescoping stack, shaking and dumping grates, and dumping ash pan. The boiler has good reserve capacity, and a special arrangement of the tubes permits of easy cleaning of the crown sheet. A dry pipe is provided and every precaution taken to secure dry steam under the worst conditions.

The crane is self-propelling by means of gears driving on one axle of each truck, but this gearing in no way interferes with the free movement of the

trucks. A friction drive is provided in the gearing to each truck, so that any inequality in diameters of drivers is readily taken care of. Self-lubricating centre and side bearings make the crane superior to most rolling stock for taking sharp curves, and the car will drive with load suspended at either end.

The crane has complete air brake equipment, both automatic and straight air. By means of permanent pipe connections from the crane to the car, the straight air system affords means of complete control by the crane operator. The crane is principally composed of steel, very little cast iron entering into its construction.

UNION PACIFIC'S NEW BOILER SHOP AT OMAHA.

Union Pacific Shops at Omaha.

In 1902 the Union Pacific Railroad Company began the construction of an entirely new shop plant, on the old shop grounds at Omaha, Neb., and since that time work has been carried on as rapidly as possible, consistent with the continual operation of all departments of the plant during the construction.

The work was commenced with the construction of the big machine shop, followed by that of the power house, store buildings, auxiliary roundhouse, boiler shop, office and laboratory, and the blacksmith shop, with an entire new car plant now under construction, consisting of coach shop, freight car repair shop, truck and wheel shop, coach paint shop, and paint storage house, and, with the planing mill, dry kilns, lumber sheds and foundry, the plant will be complete.

With the building of the new car shops, which are partially completed, the power plant has been greatly increased to furnish power to these buildings, including the installation of additional boilers, modern coal and ash handling machinery, condensers, and electrical equipment. The power plant now consists of two 250 K.-W. Westinghouse compound engines, direct connected to Westinghouse generators; one 75 K.-W. Westinghouse compound engine, direct connected to Westinghouse generators; two 500 K.-W. Parsons turbines, direct connected to Westinghouse generators; two 1,000-ft. Ingersoll-Sargeant air compressors.

The boiler plant contains ten 250 h. p.

OFFICE BUILDING AT THE OMAHA SHOPS OF THE UNION PACIFIC.

internally fired boilers, with Jones underfed stokers, and link-belt coal and ash handling machinery. All the large machines throughout the plant are individual motor driven, while a few of the small machines are arranged in groups, and are driven from overhead motors.

The power for the new car shops will be furnished entirely from the 500 K.-W. shop is connected with the paint shop by a 90-foot electric transfer table, one of the largest in this country.

Coaches coming to the shops for repairs are stripped and the various parts and furnishings are distributed to the cabinet shop, plating room, upholstering room, varnish room, or to any of the other departments for repairs or renewals. The

NEW MACHINE SHOP, UNION PACIFIC, AT OMAHA.

Parsons turbines, delivering alternating current to the car shop at a voltage of 400. The 250 K.-W. and the 75 K.-W. machines are 220 volt direct current, and switch boards are arranged so that the Parsons machines, which are alternating, can be converted to direct current and used on the 220 volt line in the locomotive department.

The car department plant includes the coach, cabinet, freight car, truck, wheel and axle, and paint shops and freight car repair yard. This plant, with the mill, dry kilns and lumber sheds and yard, will be ready for operation this year. The car department is provided with a substore department, to facilitate the delivery of coach, after the repairs have been completed, is delivered to the paint shop, and after being painted, varnished, etc., it passes out of this shop ready for service, the same system being used for car repairs as for locomotive repairs—i.e., a continuous forward movement.

For the removal of the trucks from coaches, or for re-trucking, the car department has been provided with a 60-ton crane. After removing the trucks, which are sent to the wheel and truck shop, the car is mounted on temporary trucks and passes through the shop for repairs. The wheel and truck shop is equipped with overhead traveling cranes, for handling trucks and heavy material,

NEW CAR SHOPS AT OMAHA ON THE UNION PACIFIC.

material; and the different shops, yards and material platforms have been so placed that the cost of handling material has been reduced to a minimum. Conveniently located near the paint shop is an independent fireproof building for the storage of paints and oils. The coach electric trolleys, and electric derrick cars for handling wheels and axles to and from the storage platforms and in the shops.

The freight car shop is unusually large, with overhead traveling cranes for handling cars and heavy material, and is also equipped with modern machinery for the

repairing and building of steel cars. In connection with this shop, the car repair yard has a trackage capacity of 280 cars. The tracks both in the repair yard and shop are connected at each end with a ladder track, facilitating the movement of cars and allowing for the realization of that system of a continued forward movement which has been inaugurated for the handling of locomotive and coach repairs.

The repair tracks are 22 ft. centers and this yard has been well supplied by a system of narrow gauge material tracks, so arranged and connected that material can be delivered to any point of the yard with the least expenditure of time and labor. A 10-ton electric crane spanning three tracks is used for unloading wreckage and handling heavy material. Centrally located in this yard is the air-brake shop, where all air-brake material is repaired. Altogether the whole plant is a good example of well designed and carefully laid-out railroad repair shops.

All From Missouri.

Some time ago Mr. D. R. MacBain, speaking at a meeting of the Traveling Engineers' Association, said: "Road foremen of engines and traveling engineers ought not forget that they are instructors, not mere inspectors, and as good instructors they need never be without a good subject to discuss, as the men will furnish the questions in abundant volume just as soon as they realize that the instructor is also an ordinary man who does not pretend to be beyond 'showing'."

We once knew a traveling engineer who spent a lot of his time covering the road in a Pullman car and holding more or less unsatisfactory "investigations" at roundhouses. This is not the business of a traveling engineer. He ought to be a good man in his own line, and able and willing to impart his knowledge as a help to his fellow employees and for the good of the service. The right kind of traveling engineer earns his money all right.

The Falls Hollow Staybolt Company of Cuyahoga Falls, Ohio, have issued a pamphlet dealing with the subject of "Staybolts—Their Use and Abuse," written by Mr. John Hickey, who was for many years a prominent master mechanic and superintendent of motive power. He was also a former president of the American Railway Master Mechanics' Association. He is the author of several papers on the construction and care of locomotive boilers. The article is clear and candid, and in pamphlet form will be sent free to any railroad official who writes to the company for a copy.

The Dukesmith School of Air Brakes of Pittsburgh, Pa., is an educational institution which carries on a system of instruction in air brake matters by means of correspondence. The motto of the school is "by reviewing what we think we know, we learn to know what we know we know." The course comprises instruction in the Westinghouse, the New York and the Dukesmith air brake systems. The course of study consists of twelve sections and a diploma of graduation is issued to the student on the successful completion of the course. A text book and colored charts are supplied to students. A number of air brake experts connected with the various railroads throughout the country constitute a consulting and advisory board for the school. Mr. F. H. Dukesmith, Wabash building, Pittsburgh, Pa., will be happy to supply further information on this subject to those interested.

Railroading is a popular subject at Sibley College, Ithaca, N. Y. For the first term the major railway course has a class of 87 seniors. A one-hour course on the locomotive has been elected by 41 seniors who desire that much acquaintance with the chief single agent in land transportation; and a weekly Railway Club of 29 seniors and juniors gives practice in engineering discussions, with required reading of general railway periodicals, and the card index habit for each member. A lecture and discussion course upon discipline and management of men in shops has been given to 18 seniors.

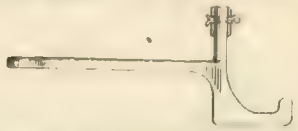
Catching a Runaway.

One of the finest stories in the history of the railways centres round a runaway engine on the Stockton and Darlington line. The engine was observed by the driver of another and more powerful one. Seeing the fugitive speeding in the direction of Darlington he uncoupled his own engine, crossed the points and set out in pursuit on the same line. It was a long chase, but the pursuer, driven at top speed, gradually overhauled the runaway. At last it came near enough for the driver to crawl to the front of his engine and drop a stout chain over the tender hook of the other. He returned to his footplate, shut off steam and screwed down his brake. This steadied the one in front and so retarded its pace that the driver was able now to creep from his own engine on to the runaway, put on the brake, and bring it to a standstill, almost in the crowded Darlington station.—London *Standard*.

The Erie Railroad offices have been removed from No. 11 Broadway to the Fulton Building, Hudson Terminal, 50 50 Church street. The office of Mr. J. H. Maddy, special representative, is in room 1077, telephone No. 8480 Cortlandt.

Steam Hose Lock and Support.

There is a very neat and useful little device which is quite in step with the progress made in art of heating railroad cars with steam. It is well known that



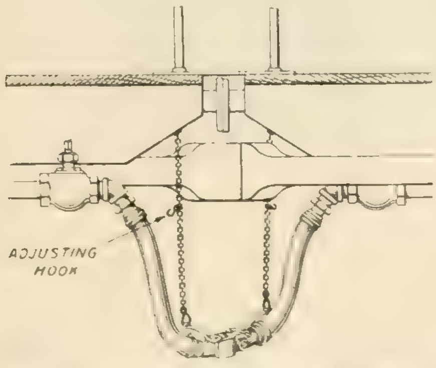
LOCK AND HOSE SUPPORT

the use of larger hose and heavier couplings for long passenger trains has made the problem of tight joints and hose protection one of greater importance than ever before. There are now higher steam pressures carried in the train pipes, for the heating of these long trains. The jarring on fast runs causes considerable leakage of steam, especially on curves.

By the new device the hose is relieved of the weight of the couplings when coupled or separated. The couplings are supported by a chain attached to the platform end sill in the usual way. The device, which has been designed by the Gold Car Heating and Lighting Company of New York, consists of a connection between the chain and hose coupling made by a lever or lock, hinged on the coupling and bearing on the coupling of the adjacent car in such a manner as to force the gaskets into close contact. This removes all the weight from the hose and presses the gaskets together with a force greater than that due to their weight and to the action of the cam and wedge, which are still retained as integral parts of the coupling.

AUTOMATIC LOCK AND HOSE SUPPORT

The lock is made of drop forged steel, and, while light, is amply strong for the



STEAM HOSE COUPLED WITH GOLD'S LOCK AND SUPPORT.

work required of it. It can be applied to existing Gold couplings with little or no trouble. In case the couplings have an eye cast with the body, the lock is simply passed through the [illegible] and secured with a cotter. For couplings which have no eye, a clamp is provided [illegible] ing the eye or fulcrum. T[illegible] be of such length as [illegible] the couplings when in use at from [illegible] and-a-half inches higher than they would be if supported by the hose alone. The chain is provided with [illegible] hook for making further adjustment if required.

Trainmen are supposed to hook up the couplings when separated [illegible] sometimes neglectful and damage to hose and couplings is very often the result. Gold's combination automatic lock and hose support prevents neglect and [illegible] does away with the possibility of damage. With this device in use the hose is always supported by the chain and never carries the weight of the couplings, thus the bending of the rubber hose at either end is entirely eliminated. This means longer life for the hose, and as the supported coupling cannot drag or catch on anything as it is kept out of harm's way. The tighter joint which is gained by the use of the lock prevents a waste of steam. The whole thing is simple, easily applied, and cheap, and the total result spells economy.

As an example of the benefits of this lock in preventing leakage at the gasket, it was found that with a coupling weighing 8 lbs. there would result a pressure agains the faces of the gaskets in contact of about 200 lbs. Additional pressure can, if desired, be produced by simply increasing the length of the [illegible] of the lock, which is really a lever. [illegible] during the past winter on [illegible] railroads has proved that the lock is all right for maintaining tight joints. This [illegible] has been designed in [illegible] several purposes, among [illegible] the automatic locking of steam [illegible] and the proper support of the hose and coupling. When you [illegible] ment you will know [illegible] and if you wish any information on the

subject, write to the Gold Car Heating and Lighting Company, Whitehall Building, New York.

A circular, which tells its story pictorially and by a few direct words, has lately came to our office. It is issued by W. H. Nicholson and Company, of Wilkes-Barre, Pa., and it deals with Nicholson's patent expanding lathe mandrels. The sizes, and the amount of what the makers call the "expansion" of each mandrel, are given, also the length of the arbor and the length of the jaw bearing are there, and the price is given. The arbor is an ordinary cylindrical bar of steel turned parallel with four tapered grooves in it. Over the mandrel is a short sleeve, which slides on it from end to end. In the sleeve are four slots corresponding to the four grooves in the arbor. In each groove and slot and projecting above the sleeve there is a taper key. When you move the sleeve toward one end of the arbor the keys sink in the sleeve. When you move the sleeve in the other direction—that is, toward the shallow ends of the grooves—the keys rise a little in the sleeve. Thus, for No. 1 mandrel the keys will just fit a one-inch hole when at their "smallest" and they will fit a $1\frac{1}{4}$-inch hole when "expanded" by being pushed to the other end and at all intermediate positions they will fill any hole between those limits, and so on for all the sizes made. The upper edges of the keys are parallel, and as their under sides just suit the taper of the slots the keys will bear evenly on the interior of a bushing or other hollow article throughout their length. The whole idea of the mandrel is scientific and its use saves a lot of time and bother. The makers very truly say "What's the use of a high speed lathe if the time it saves as compared with a slower tool is wasted at the mandrel pile?" Write for the circular; it's worth a post card.

Progress isn't a passing fancy; it's the life principle.—*Elizabeth Robins.*

An Unanswerable Question.

John F. McIntosh, the popular locomotive superintendent of the Caledonian Railway, has a fine, intelligent family of lads and lasses, of whom the parents are justly proud. Brought up as they were in an engineering atmosphere the boys were encouraged to acquire knowledge by asking questions. One of them developed so much persistence in this respect that he was frequently embarrassing to the father.

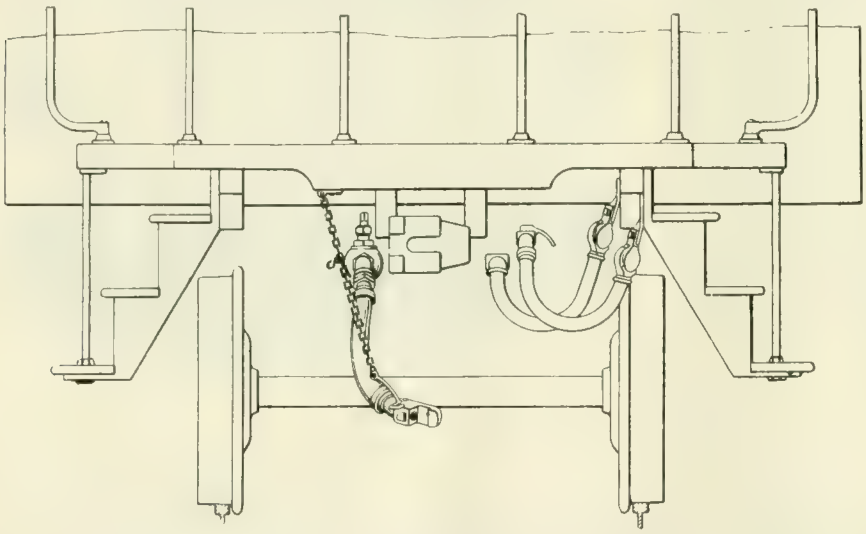
One evening the dad became out of patience and exclaimed, "Now, sonny, don't ask me any more silly questions or I shall send you to bed."

"But this is not a silly question, Dad. I only want to know what complaint the Dead Sea died of."

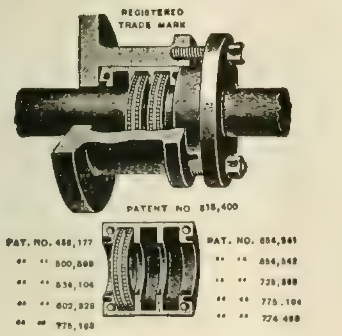
"Go to bed at once, you little tease."

About three years ago the Harbison-Walker Refractories Company of Pittsburgh, Pa., makers of fire clay, silica, magnesia and chrome brick, erected a special plant at Templeton, Pa., for the manufacture of high grade front building brick. This brick has been used on many of the largest and most important office buildings, schools, hospitals, court houses and residences that have been erected in New York and in other parts of the country. This company recently closed a contract with the trustees of the Carnegie Technical Schools, of Pittsburgh, Pa., for over 2,000,000 of their high grade, light-colored front building brick for use in the erection of this great group of buildings.

Frugality is good, if liberality be joined with it. The first is leaving off superfluous expenses; the last is bestowing them to the benefit of others that need. The first without the last begets covetousness; the last without the first begets prodigality. The two united make an excellent temper.

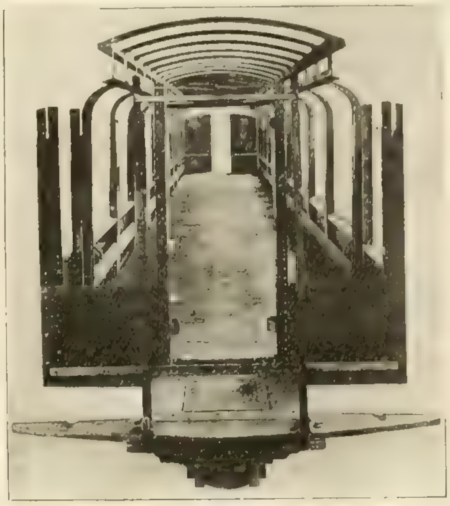


POSITION OF GOLD'S STEAM HOSE WITH PERMANENT CHAIN AND LOCK.



Pennsylvania All Steel Coach.

The first all steel passenger coach of the order for 200 placed by the Pennsylvania Railroad Company last year, has just been put into service between New York and Philadelphia. The coach is 70 ft. long, and is the heaviest car of its kind which has been built. The mahogany window sashes and seat frames are the only parts made of wood in the coach. It is as nearly fireproof and collision-proof as, in the present state of the art, it is possible to make it.



FRAMING OF STEEL COACH.

This car, No. 1652, has seats for 88 persons. Its total weight is 116,000 lbs. or just fifty-three tons. It is hoped that in later designs this weight may be somewhat reduced. The standard modern coach weighs only about 84,900 lbs. For every passenger carried, the new coach has a dead weight of 1,300 lbs. of open hearth steel. Each truck weighs about 12,500 lbs.

The feature of construction, and that which is intended to secure the car against the dangers of collision, is the central box girder, 24 ins. wide by 19 ins. deep, extending throughout the length of the coach. To further insure the car against collapsing, its frame structure has been built upon the principle of the cantilever bridge, suspended on the trucks as piers.

A coupler of a new type, stronger than anything used before, has been designed for this car to reduce the possibility of breakage and the consequent parting of the train. The floor of the car is of magnesium cement, laid on corrugated iron. The coach is lighted by electricity, derived from train generators or storage batteries. The heating and ventilating of the car has been carried out on the most improved principles. Coach No. 1652 was built in the Pennsylvania Railroad Company's shops at Altoona, Pa., and is one of the large order for all-steel passenger cars, 25 of which are to be built at Altoona, 90 by the American Car and Foundry Company, and 85 by the Pressed Steel Car Company, of Pittsburgh. It is the declared policy of the Pennsylvania Railroad Company to have future passenger equipment of all-steel construction.

PENNSYLVANIA ALL STEEL COACH.

We have recently seen a very neat model of the Allfree locomotive valve and cylinders, operated by the Walschaerts gear. The model is a sheet of white metal in a little frame measuring about 7 × 5 ins. Cylinder and valves are on one side and the Walschaerts gear on the other, the whole operated by a driving wheel disc with a milled edge like a silver coin. The outline of the steam chest and cylinder are raised about ⅛ of an inch and in them a flat piston and valve of copper, the same height, are made to move. The main valve is of the piston type, inside admission, and in its travel moves the compression valve, also of the piston type. The delay-action of the compression valve is thus very clearly shown. The Walschaerts gear on the "obverse" of the model is not reversible, but is a neat little piece of mechanism. The Locomotive Appliance Company, of Chicago, manufacture locomotive cylinders and valves under the Allfree patents. An engine fitted with these valves and cylinders on the Rock Island is illustrated and

described on page 206 of this issue. A very full and complete description of the valves and cylinder, with half tone and sectional line cuts, has been published by the company in a catalogue which has just come from the press. This catalogue, which is well worth perusal, will be sent free to anyone writing to the Locomotive Appliance Company, Old Colony Building, Chicago. The method of steam distribution and the claims made for the Allfree system are clearly explained in the catalogue.

"Ruberoid Pete" is the name of a little pamphlet printed in colors which tells in a readable way all about Ruberoid roofing, a thing which the makers say, when you come to roofing, is good for anything from a hencoop to a mansion. If you want to know what this roofing is and what it will do, this pamphlet gives the information, and it presents it in an attractive way. The Standard Paint Company of New York make ruberoid and they will be willing to send this pamphlet to anyone who is genuinely interested in roofing, so if you are, let them have your name and address.

Crayons are proving extremely popular with engineers and surveyors for marking purposes. Prominent engineers of two of New England's largest railroads have recently highly complimented the Dixon Co. for their Yellow Crayons. In surveying work on railroads the Yellow Crayons are used for marking various points on the rails. For such work the ordinary chalk is likely to wash off after a rain storm. Dixon's Yellow Crayons, however, leave a clear mark for months. One case was recently reported where the marks were seen distinctly after eight months' exposure to the weather. The standing committee of the Pittsburgh Railway Club recently recommended that one of the rules of car interchange be altered so as to enforce the use of ink or black indelible pencil for making out defect cards. If this suggestion is acted on by the M. C. B. Association, then indelible pencils making a decidedly black mark will be in order, and the Joseph Dixon Crucible Company, of Jersey City, N. J., have the very kind of pencil required.

A paradox is something which is in seeming contradiction to a generally received belief. It is a puzzling fact. That is why the Cleveland Twist Drill Company, of Cleveland, Ohio, have called a class of reamers which they make by that name. The Paradox reamer is adjustable in the tool room and solid in the shop. The blades of this reamer are held down and in against the back and bottom of the grooves in which they fit by taper-headed screws. The blades are unevenly spaced to avoid chattering and they extend exactly to the end of the body, so that clean, true reaming can be done to the bottom of a blind hole. The adjustment is made by removing one or more blades and lining the bottom of the groove with tinfoil, putting back the blades and tightening them in place. The same reamer can be made to ream holes of different diameters, and the adjustment can be made exceedingly fine. When the blades do become worn out in service they can be renewed and the body is always good. If you want a catalogue or even a folder, of which there are two, artistically printed and telling the story very plainly and clearly, write the company and they will send you one or all.

The term "light locomotives" has to be understood in a certain sense and that sense is brought out in the new tenth edition of the H. K. Porter Co.'s catalogue, which has just been received. This catalogue is devoted exclusively to the illustration and description of steam locomotives, is up to date in every way and the locomotives shown are models of modern practice. The catalogue also contains about 80 pages of useful engineering information not found usually in print. The company are now prepared to build locomotives up to 17 in. diameter cylinders, and their facilities for taking care of a large amount of work and for turning out the highest grade of work were never better. The wide range of sizes and designs of locomotives which this concern are supplying is very remarkable. Since they issued their ninth edition catalogue the progress made as regards the power and efficiency of their locomotives has been greater than during any similar period of their history. They inform us that their export as well as their home trade has increased very largely. If you are interested write to the H. K. Porter Company, of Pittsburgh, Pa., for a copy of the catalogue.

The month of May might be thought rather late in the year to talk about calendars. Perhaps it is, but a calendar which we have found very useful is the one issued every three months by the Storrs Mica Company, of Owego, N. Y. It gives the dates of the meetings of the various railroad associations, railroad clubs, etc., and it also gives the place where the meetings are to be held. If you think such a calendar would help you to keep track of these things, ask these makers of mica headlight chimneys to send you a calendar. They call the chimney the "neverbreak"; they might call the calendar the "never forget."

A very good preparation for cleaning and polishing highly finished surfaces and for bringing back the original

luster has been put on the market by Chas. E. Hatt & Chemical Company, of Detroit, Mich. What the makers call the "cleaner and polish" is for use on any smooth surface, either enamel or hard oil finish, that is dirty but still has the finish underneath. It is intended to remove dirt, grease, finger marks, ink spots, fly specks, water marks, etc. It is useful in cleaning up office furniture, interior woodwork. We have tried it on our own office furniture after the moving of our whole establishment to 114 Liberty street, and we find it is all right. It is also good for passenger car panel work, car seats, etc.

What the makers call the "combination rubbing polish" is a rub and polish in one. It takes care of heavier work than the cleaner and polish. It is for use in renewing a polish that has become deadened from exposure or long standing without attention. It will fill in and remove the marring effect of light scratches and dents. By following the combination rubbing polish with an application of the cleaner and polish, we are told, the finish will be restored to a condition as clean and brilliant as when it first left the shop, and this with a saving in time and labor. Write to the company for further information.

The executive offices of the Westinghouse Electric & Manufacturing Company, formerly at 111 Broadway, New York, N. Y., and the New York sales offices and export offices of that company, at 11 Pine street, were recently removed to the new City Investing Building, No. 165 Broadway, New York.

A novel feature of the coming Master Mechanics' Convention at Atlantic City will be the exhibit of the Committee on the Apprenticeship System. It is expected that all the railroads operating apprentice schools will send models, drawings and photographs to show in a comprehensive manner the rapid advancement which is being made in this phase of railroad activity. The following roads have already consented to exhibit: The Central Railroad of New Jersey, the Grand Trunk, the New York Central Lines and the Santa Fé.

The Modoc Soap Co. of Ohio, with its Philadelphia office, 228 North Fourth street, has adopted the word "Perfectol" as a trade mark for their well-known car cleaner and their other products, namely, renovator, powdered soap and oil soap. This company has just completed its fifteenth year of successful career.

A Fat Mind.

About a quarter of a century ago the famous child's story for grown-ups, "Alice in Wonderland," came out in England [illegible] Lewis Carroll, who was in reality C. L. Dodgson, an Oxford professor of mathematics. A lecture, delivered [illegible] Lewis Carroll, has lately been brought out under the title of "Feeding the Mind." In it the author humorously refers to the possibility of there being such a thing as "a fat mind." By this is probably meant a mind so overloaded with a mass of what may be called undigested or unarranged facts as to become slow, heavy, and inactive. Constant and even diligent reading may thus become actually harmful. Reading to be of value must be followed by the process of assimilation.

The mind as well as the body needs food of the proper kind, and mental food has to be digested in order to result in mind growth. Thinking over what has been read is the form which mental digestion takes, and of that process Lewis Carroll says, "This is a very much greater exertion of mind than the mere passive taking in the contents of one author. So much greater an exertion is it that, as Coleridge says, the mind often angrily refuses to put itself to such trouble—so much greater that we are far too apt to neglect it altogether, and go on pouring in fresh food on the top of the undigested masses already lying there, till the unfortunate mind is fairly swamped under the flood. Sam Slick tells us that he had learned several languages in his life, but somehow 'couldn't keep the parcels sorted' in his mind. And many a mind which hurries through book after book without waiting to digest or arrange anything gets into that sort of condition."

CONTENTS

INDEX TO ADVERTISEMENTS.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXI. 114 Liberty Street, New York, June, 1908 No. 6

The Atlantic City Flyer.

Our illustrations for this, the "leafy month of June," show the Atlantic City Flyer on the Philadelphia & Reading, or what may be called the railroad speedway of America, the road between Camden and Atlantic City. The distance between these two points, to be very exact, is 55 6-10 miles and the road is double-tracked, block-signaled and balasted with anthracite cinders. The engines used on these runs burn hard coal. The road itself cannot by any means be described as a billiard table as far as level is concerned. There are three short grades, 42 ft. to the mile, one grade 48½ ft. to the mile and two 50 ft. to the mile, on the road, but the trains run over the line with the smoothness and steadiness of the ivory ball on the green cloth.

The engines which haul the flyers are of the Atlantic, or 4-4-2 type, and were built at the Baldwin Locomotive Works in Philadelphia. The name "Atlantic" given to this type of engine originated with the engines originally designed by Mr Samuel Vauclain, superintendent of the Baldwin Works, for the Atlantic City run, Camden being a suburb of the Quaker City. The original "Atlantics" were four-cylinder or Vauclain compounds and it was on one of these that Angus Sinclair made the trip which he described in the columns of this paper for August, 1898. The Vauclain compounds had cylinders 13 and 22 x 26 ins., 84¼-in. drivers. That the Philadelphia & Reading has kept up its high reputation for speed and safe traveling may easily be seen from a glance over Mr. Sinclair's remarks of ten years ago, and comparing the daily performance then with the train speed maintained at the present time. Our chief editor intends to visit friends in the British Isles this summer after the M. M. and the M. C. B. conventions are over, and his observations made in 1898 were at that time previous to a trip to the old land. He said: "It has been my privilege to ride on a great many fast trains in America and Great Britain. I have a habit of carrying a stop watch and of using it to time the speed between mile posts, which practice has given me positive evidence of the speed attained or maintained.

"After watching the speed of celebrated trains in the British Isles, I have at certain times been moved to remark to railway men and others that some trains in America made better time than those of other countries. When I proceeded, by referring to my note book, to give particulars, the best of friends would regard me with a pitying smile which said as plainly as possible 'he has acquired skill in the Yankee habit of boasting and lying.'

"As I am going to be visiting among railway friends abroad for a few weeks I wished to witness for myself the run of the fastest train in the world, that runs from Camden to Atlantic City, a distance of 55.5 miles in 50 minutes, an average speed of 62.2 miles per hour.

"Through the courtesy of Mr. Theodore Voorhees, vice president of the Philadelphia & Reading Railway, I re-

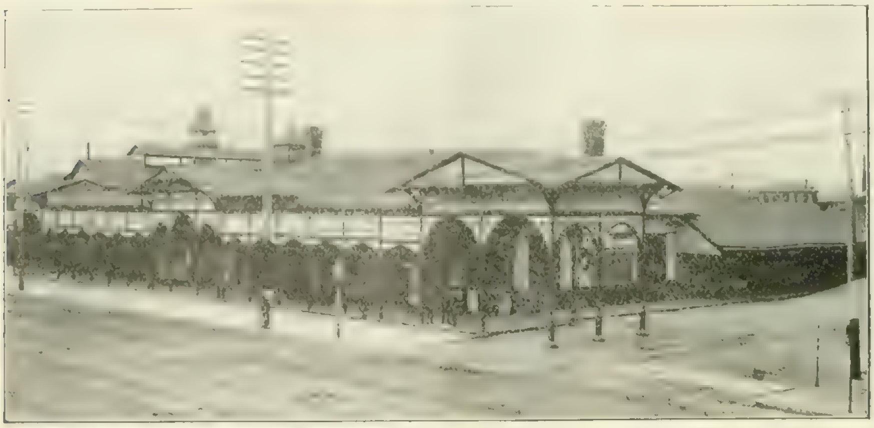
THE ATLANTIC CITY FLYER ON THE PHILADELPHIA & READING.

ceived permission to ride on the engine of that celebrated train. The train is due to leave Camden, which is across the Delaware River from Philadelphia, at 3:50 P. M., and I was there in good time to witness the preliminary touches given to the locomotive before starting upon a trip that must put a severe test upon various elements of the engine.

"Half an hour before starting time the engine was backed up to the train, which consisted of seven passenger cars. I happened to be exceptionally fortunate to take notes of an extraordinary feat of fast train running, for it was the first time that seven cars had been hauled on this train, five or six cars having been the usual load last season. Each car averages 75,000 lbs., and the engine, in working order with tender, weighs about 218,000 lbs, so there were 525,000 lbs. of train, making a total of 743,000 lbs., or 371½ tons, to be moved. I found a crowd of interested admirers about the engine watching every move of the engineer and fireman, both of whom were quietly attending to the duties of preparing the engine to do its work without chance of failure.

"The engineer, Mr. Charles H. Fahl, kept moving about the engine scanning every part, and dropping a little oil on the parts that needed the greatest amount of lubrication. While I remained watching him he oiled the principal bearings twice, and then carried his cans to the cab, apparently satisfied that his full duty had been performed. The fireman, Mr. John Pettit, was engaged throwing a few shovelfuls of coal at brief intervals into the enormous firebox, which has 86 sq. ft. of grate area, and watching at intervals to find a thin spot that needed covering up.

"These trains were run for three months last year on the 50 minute schedule, with the same men on the engine, without a single mishap, or without losing a minute of time. The engine never had a hot pin or bearing, and, in spite of the tremendous work put upon it, was always ready to turn round and take out another train without a minute's delay. That fine record was due to the care in seeing that everything was in good order before the start was made. In conversing with Vice-President Voorhees I found that he attributed the successful running of this train in a great measure to the care and skill of the engineer and fireman.



THE ATLANTIC CITY TERMINAL OF THE READING.

"At 3:50 precisely the signal came to start and the engine moved ahead without slip or quiver. A few turns of the great driving wheels forced the train into good speed and away we rushed out through the yards, through the suburban residences and away past smiling vegetable farms. On reaching the first mile post to be seen, which was about a mile out, I had my watch in hand and the second one was passed in 68 seconds. An interval of 62 seconds brought us to the following post, and then the succeeding notations were 60, 59, 56, 52, 50, 48, 46, 52, 53, 53, 51, 50, 52, 49, 50, 53, 52, 50, 49, 44, 45, 42, 44 seconds for each succeeding mile. Then I made up my mind that the high speed was authentic and put my watch in my pocket the better to note particulars about the handling of the engine.

"I was sitting on the firemen's side and could not see how the engineer was handling his reverse lever and throttle lever, but I noticed that there was no change in the point of cut-off after the train was going forty miles an hour, and it seemed to me that the steam was permitted to follow the piston at a little more than half stroke. The steam pressure gauge could be easily noted, and the safety valve blew off at 230 lbs. gauge pressure. The fireman appeared to do his best to keep the pressure about five pounds short of the popping point, and he did his work well, but the indications were that he had more difficulty in keeping the steam down to the popping point than in letting it rise. He did not seem to work much on the fire. He watched it very closely, and threw in a few lumps occasionally, but there was no hard work in supplying all the steam needed to do the enormous work of pulling the heavy train at the speed noted. The coal used was small lump similar to house furnace coal.

"The road is a little undulating, but the rises and descents seemed to make little difference to the speed. Out through stretches of farm lands, away through spreading woods and moor-like regions of scrub oaks the train rushed along, neither curve nor grade seeming to restrain its velocity. The engine rode with astonishing smoothness. When I have ridden on other engines working hard and keeping up speed over 70 miles an hour, there was always a harsh vertical vibration due probably to the jerk of compression, but that disagreeable sensation was entirely absent in this compound. The work done gauged in horsepower per hour was enormous, and perhaps unprecedented for a locomotive, but it was performed with remarkable smoothness, and the impression was always present that the engine still had some margin of power in reserve which could be used if necessary.

MODERN 4-4-2 ENGINE ON THE P. & R. FLYERS.

"About four miles from Atlantic City a signal was against the train and the speed was reduced to about 20 miles an hour before the signal was lowered. That was about three-quarters of a mile from the succeeding mile post. I noted the time from that mile post to the next one and the mile was run in 60 seconds. That will give a good idea of the power of the engine. Two minutes was used in running the last two miles through the switches. At least one minute was lost with the signal check. With these deductions I calculate that the average run was made at a speed of over 70 miles an hour."

The engines used to-day, such as is shown in our frontispiece, are simple with cylinders 21 x 24 ins. and driving wheels 84¼ ins. in diameter. The main valves are of the Richardson type, double ported. The steam pressure carried is 230 lbs. The engine weighs about 117 tons. The tender carries 8 tons of coal and holds 6,000 gallons of water. The 4 o'clock express ex Camden, as our English friends would say, is composed of one of these engines, one combination car holding 64 persons and four other cars having a seating capacity of 94 persons each, and two parlor cars. The 5 o'clock down express has one more coach.

The train of seven cars weighs about 334½ tons and with the engine and tender the weight moved comes up to about 438 tons, which is a greater load than ten years ago. This engine, as well as others of the same class, have made spurts during their runs of from 90 to 100 miles an hour. It was a frequent occurrence to make the run from Camden to the shore in 45 and 46 minutes. At the mile a minute speed the drivers make a fraction over 264½ revolutions and the piston speed is close to 1058 ft. per minute.

The daily running of these trains with their modern equipment, their precise movement and their swift pace is, the year round, a steady performance without hurry and without fuss. They are like shuttles flashing back and forth, weaving their tight drawn strands in the web of a nation's commerce, as they ply in ordered sequence between the little town of Camden and the city by the sea.

A recent press dispatch from Ottawa, Canada, states that, "The Railway Commission has issued a circular to all the railway companies referring to a complaint, that many locomotive headlights are in poor condition, and stating that the commission is considering the adoption of regulations which would require the use of electric or some other form of head-light which would do away with these complaints."

The water and the steam in the boiler have the same temperature.

Something About Draw Gear.

Wheels and draft gear are the two pre-eminently important items of expense to-day in car maintenance, and with the increasing number of fifty ton all steel cars and cars with steel underframes in service, the cost of draw gear repairs and loss of service of the cars themselves owing

THE MARLBORO'-BLENHEIM ATLANTIC CITY HEADQUARTERS OF THE EXECUTIVE COMMITTEES M. M. & M. C. B. ASSOCIATIONS.

to this item, make it of the greatest importance to railroad companies. Thus in effect spoke Mr. R. P. C. Sanderson, superintendent of motive power of the Virginian Railway, in a recent address to the New York Railroad Club.

The speaker began by dividing the subject into four heads. These were the coupler, the attachments, the abutments, or attachments to the car framing, and the cushion, generally called the draft gear. All these are subjected to various forms of shock and strain. There is only one reliable source of information as to the magnitude of jerk shocks, and that is the dynamometer car record. Examination of such records shows that in heavy service the majority of jerk shocks are below 180,000 lbs., those going over this being rare. The speaker said he had seen the record of shocks run close up to 300,000 lbs. Apart from the severe jerk shocks reaching up to and over 100,000 lbs., there are a continuous succession of serges or impulses transmitted through the draw rigging of trains in service ranging below 35,000 lbs., interspersed with occasional shocks above this and under 100,000 lbs.

Buffing shocks run from 5,000 lbs. up to an unknown quantity. Dynamometer records show blows going over 300,000 lbs. A few figures made by anyone as to the blow struck by a 50-ton car, even at moderate speeds, will convince him that the blow can never be fully cushioned. A loaded 50-ton car moving at 4 miles [illegible] through a friction gear, to the frame. It [illegible] r 20 cars moving at this speed. They all go beyond any reasonable chance of being fully cushioned.

Cars are, of course, not perfectly rigid when struck, but yield more or less as they are coupled to others, and as the brakes may be set or not and as the framing may be more or less elastic the draw gear cushion may thus become

ONE OF THE FERRY SLIPS AT CAMDEN

practically effective. The force of the blow is often mitigated by the nature of the load, which may shift a little, and so help in reducing the punishment. Probably the worst battering ram moved on a railroad is a full oil tank car, but perhaps a dead locomotive may be worse. We must give up all ideas of entirely cushioning the buffing shocks.

A well made steel coupler of reasonable weight will stand more than the M. C. B. requirement of 120,000 lbs. without frac-

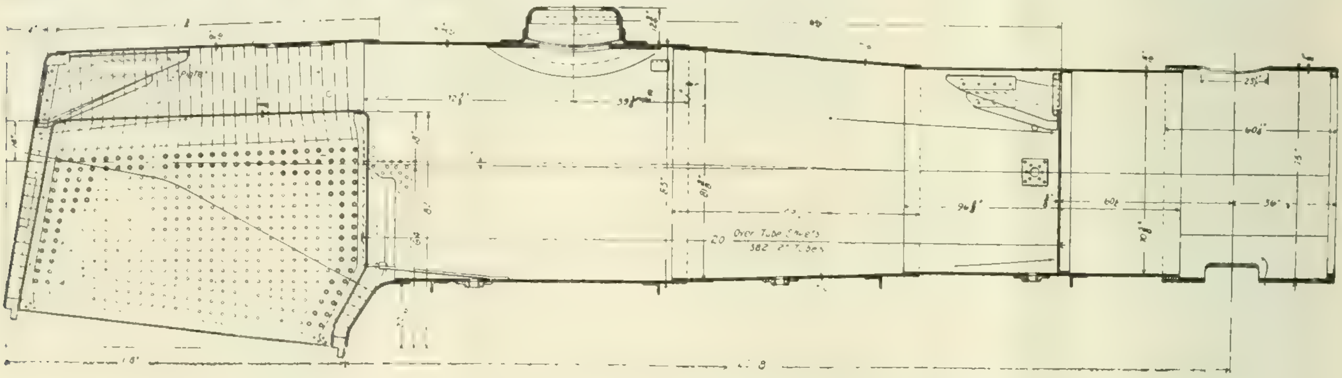
the [illegible] taken. It will also stand anything in the way of jerk shocks that is worth while providing for, say 180,000 lbs. The coupler head is not as well designed to stand buffing shocks, especially when delivered on curves, as it is to stand pulling shocks. The horn was added to the M. C. B. coupler to prevent it being driven in between the draw timbers when buffing shocks were generally within the limits of the coupler head. We have gone beyond that now, and the head is in need of protection.

The speaker was of the opinion that an oak cushion between the dead blocks and the steel end sill of the cars would be of great value in mitigating the shattering effect of heavy blows. The horn of the coupler should not come in contact with the end sill unless the dead blocks give way. The 5x7 in. coupler shank, when made of good annealed steel of proper weight, has proved itself to be amply strong, and when protected by dead blocks has a greater margin of strength.

There is room for improvement in the coupler butt. Drop tests show that the generally used is about 160,600 lbs. when two of them are closed solid. If we endeavor to multiply their number or increase their strength something like up to the needs of the case, we introduce dangerous conditions of recoil. Those who have seen the way a pair of springs will bounce a drop-machine striker weighing $4\frac{1}{2}$ tons up and down after impact, will appreciate the danger of breaking trains in two where spring recoil can get in its work. To be successful in heavy service, the draft shock cushion must be able not only to ease off the blow, but to ease off the recoil action of the spring.

Continuing, Mr. Sanderson said: "During the ordinary running of a train there are continuous surges, pulls or pushes that vary below, say 35,000 lbs., and the light coupling shocks will also be around the lower ranges. It is believed to be necessary that the draft cushion should have a comparatively easy resistance for the first small part of the stroke, say one-half to three-quarters of an inch, so that these lighter blows and surges may be dissipated without causing shattering or distress of the coupler parts and their attachments, due to too much initial rigidity. The initial spring used in some gears answers this purpose very well, but no more of the stroke should be wasted on this than is absolutely necessary for a reasonably light cushion. Assuming that 160,000 lbs.' capacity is all the cushion that will be worth while to provide for jerk shocks, and that we can never hope to cushion the severe buffing shocks, it is thought that the capacity of the gear should not run above this for the present allowance of travel. To increase the capacity without increasing the travel, makes the gear too rigid. If a blow of a given number of foot-tons must be eased off, we want all the stroke or time we can get to do this in, if it is to be done well. The shorter the stroke the less effective the cushion. Some gears are constructed to do nearly all their work in the last three-eighths or one-half inch of the stroke, which is as wrong as telling a man sliding down a telegraph pole not to grip the pole tight until he is nearing the ground. The result on his spine would be much better if he grips it as tight as possible for the longest distance. Assuming that two cars strike at seven miles an hour, the moving car travels ⅜ of an inch in about the 1/300 part of a second. This is too minute a fraction of time to be effective in practice."

Concluding, the speaker said he believed that when railroads are ready to recognize the need of and to pay for more effective cushioning in draft gears than can be obtained from a first-class gear of 160,000 lbs.' capacity on 2¼ ins., it will be done by using a gear connected to the coupler of this capacity and having a stroke of say 3 ins. Directly over the coupler should be placed a friction buffer, set in a cast steel pocket riveted fast between the sills, having, say 2-in. stroke and 140,000 lbs.' capacity, with dead blocks on either side to take the final 300,000 lbs. when both gears are driven home by a 600,000 lb. shock.



LONGITUDINAL SECTION OF BOILER OF N. Y. C. 4-6-2 HEAVY PASSENGER ENGINE.

rivets will sheer long before the other parts of a well made draw gear will give way. The future form of the butt of the coupler must be governed by the change in the method of attaching the yoke or its equivalent. When a change of the coupler butt is made, it should have a wider bearing against the follower and a horn or projection to come up against the inside of the end sill or stops to prevent the coupler from being pulled out should the draft gear behind it fail. The followers, whether separate or forming part of the cushion casing, should have large bearing surfaces against the stops or abutments. Think of blows of 300,000 lbs. and allow plenty of square inches to take them on, so that they will not wear bevelled and tend to spread the sills out. They should be made, preferably, of wrought iron or soft steel forgings or low carbon well annealed steel castings that will batter, bruise and bend, rather than crack. Their form must depend on the underframe construction and the type of cushion gear used.

Coming to the question of cushion, Mr. Sanderson said the capacity of springs

American Society of Mech. Engineers.

The semi-annual meeting of The American Society of Mechanical Engineers will be held in Detroit, Mich., June 23-26. An entire session will be devoted to papers on the conveying of materials, when hoisting and conveying machinery, including belt conveyors, etc., will be discussed. Among other subjects which will be taken up are "Clutches," with special reference to automobiles, by Mr. Henry Souther; "Some Pitot Tube Studies," by Prof. W. B. Gregory, of Tulane University, New Orleans, La., and Prof E. W. Schroder, of Cornell University; "Thermal Properties of Superheated Steam," by Prof. R. C. H. Hock, of Lehigh University; "Horse Power, Friction Losses and Efficiencies of Gas and Oil Engines," by Prof. Lionel S. Marks, of Harvard University; "A Journal Friction Measuring Machine," by Henry Hess, of Philadelphia; "A Simple Method of Cleaning Gas Conduits," by W. D. Mount; "A Rational Method of Checking Conical Pistons for Stress," by Prof. G. H. Shepard, of Syracuse University, and "The By-Product Coke Oven," by W. H. Blauvelt.

Heavy 4-6-2 for the N. Y. C.

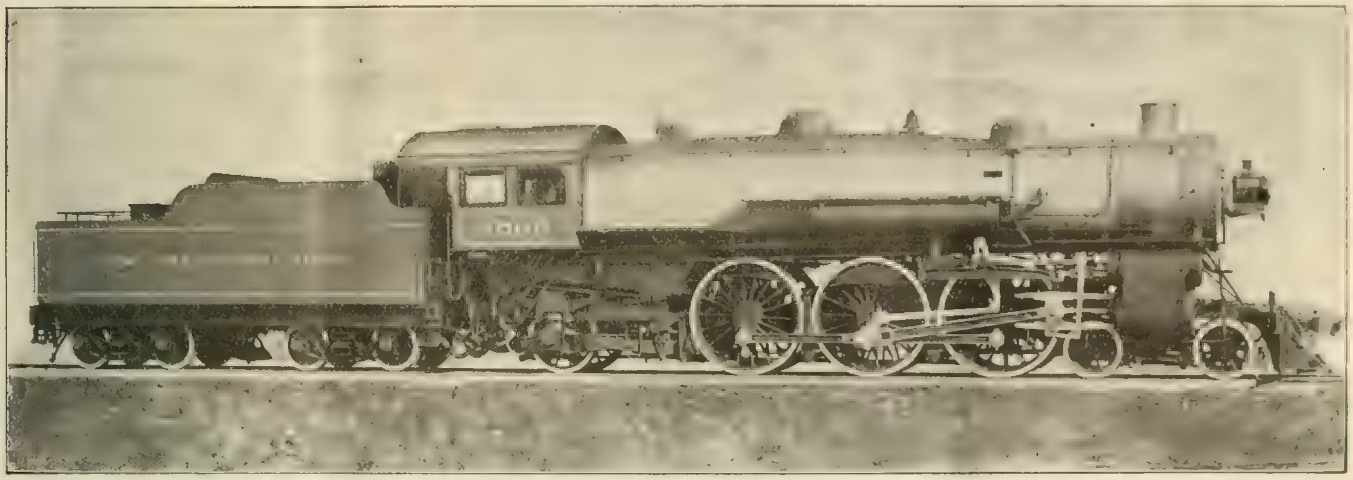
The American Locomotive Company have recently completed an order of forty Pacific or 4-6-2 type locomotives for the New York Central & Hudson River Railroad. These are the heaviest passenger locomotives ever built for this road and will be used in hauling through trains. At the present time these trains are handled by a 21½ x 26 Atlantic type engine, having a maximum tractive power of about 23,300 lbs. The reason for adopting the 4-6-2 type in the new order was because the Atlantic type engine did not have quite the adhesive weight for starting purposes.

In general the engines here illustrated are duplicates in design of a previous lot built last year by the same company for the Lake Shore and Michigan Southern Railway, which took the place of the Prairie type as the standard high speed passenger engine on that road and are now hauling all their important trains, including the Twentieth Century Limited.

In working order these N. Y. C. engines have a total weight of 266,000 lbs., of which 171,500 is carried on the driving wheels. The cylinders are 22 by 28 ins., and with driving wheels 79 ins. in diameter and a working pressure of 200 lbs., the engines can develop a maximum tractive effort of about 29,200 lbs.

The driving wheel base of these engines is 14 ft., which is short when the whole length of the engine is considered. The wheel base of the engine is 36 ft. 6 ins., while that of the engine and tender is 67 ft. 11 ins. The estimated weight of the engine and tender together is 430,000 lbs. The main valves on these engines are of the piston type actuated by Walschaerts gear. The valves are 14 ins. in diameter with 6 ins. travel set with ¼-in. lead, steam lap of 1 in. and exhaust clearance of ⅛ in.

Especial attention has been paid to working out the design to provide a boiler of the highest capacity. An examination of the principal ratios given below will be found interesting. The boiler is of the radial stayed type with a conical shaped middle ring, and the outside diameter of the front ring is 72 ins. The boiler contains 382 tubes 2 ins. in diameter and 20 feet long. Altogether the boiler provides a total heating surface of 4,210 sq. ft., of which the tubes contribute 3,982 sq. ft., and the firebox and arch tubes the remainder. The firebox is 108⅛ ins. long and 75¼ ins. wide, and has a grate area of 56.5 sq. ft. The general structural features of the design are shown in our illustrations, and the general dimensions and ratios are given below:



HEAVY EXPRESS PASSENGER 4-6-2 ENGINE ON THE NEW YORK CENTRAL.
J. F. Deems, Gen. Supt. Motive Power, Rolling Stock & Machy. American Loco. Co., Builders.

Weight on drivers divided by tractive effort	=	5.84
Total weight divided by tractive effort	=	9.11
Tractive effort x diam. drivers divided by heating surface	=	550
Total heating surface divided by grate area	=	74.5
Firebox heating surface divided by total heating surface, per cent	=	4.74
Weight on drivers divided by total heating surface	=	40.7
Total weight divided by total heating surface	=	63.1
Vol. both cylinders cu. ft.	=	12.32
Total heating surface divided by Vol. cylinders	=	341
Grate area divided by Vol. cylinders	=	4.58
Heating surface divided by grate area	=	[illegible]

Axles—Driving journals, 10½ ins. by 12 ins.; engine truck journals, diameter 6½ ins., length 12 ins.; trailing truck journals, diameter 8 ins.; length 14 ins.; tender truck journals, diameter 5½ ins., length 10 ins.

Boiler—Working pressure, 200 lbs.

Firebox—Type, wide, length, 108⅛ ins.; width, 75¼ ins.; thickness of crown, ⅜ in.; tube, ½ in.; sides, ⅜ in.; back, ⅜ in.; water space, front, 4½ ins.; sides, 4½ ins.; back, 4½ ins.

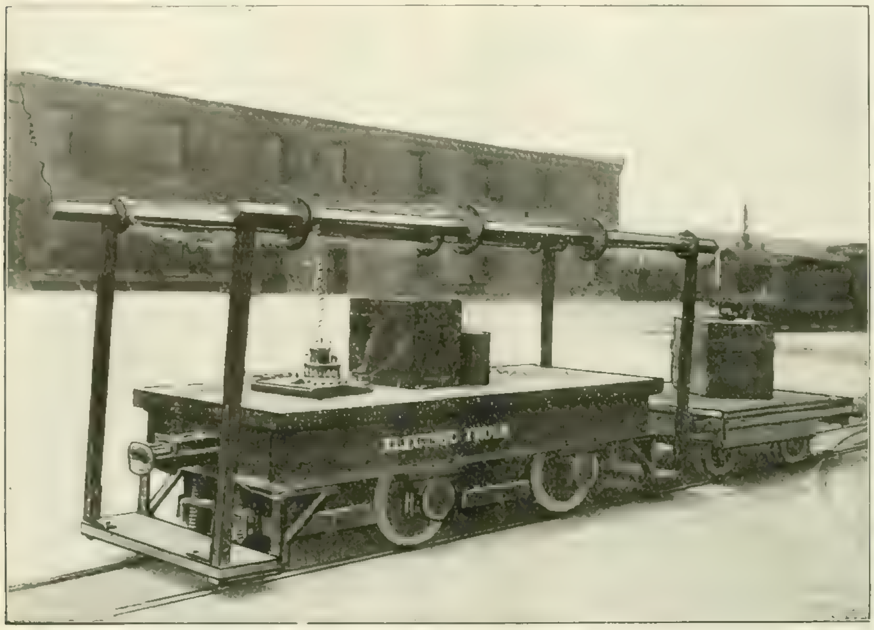
Wireless.

Running up and down a narrow gauge track in the Union Pacific shop yards at Omaha, Neb., is an electric truck weighing about three tons and drawing other trucks of an aggregate weight, when loaded, of twenty-five tons. Every movement of this truck can be controlled by the man sitting at the sending apparatus in a little room in the middle of one of the new shop buildings. The truck, with its train, can be sent forward, it can be stopped, and its speed forward or backward can be absolutely controlled by what is practically an application of wireless telegraphy.

The antennæ, which is the name given to the electrical wave-collecting apparatus on this wireless truck, are arranged in cylindrical form, 134 feet of copper wire being used in making them. They are set horizontally, one on each side of the truck and at a height of about four feet from the ground. The use of antennæ of this type permits of placing them so low on the truck or, indeed, on any similarly equipped car as to permit passing through tunnels or under bridges. Antennæ similar to those on the truck and attuned to them hang from a seventy-foot flagpole at the central station. From these antennæ controlled electrical waves move out into space and incidentally fall upon the antennæ of the truck in the yard and govern its movements perfectly, the distance of the truck from the sending station making, of course, no difference whatever.

The "tuning" of the sending and receiving apparatus to one another is very similar to that which may be made to take place with sound vibrations. Although the word "tuned" is used with reference to the wireless method, it does not refer in any way to audible vibrations. The science of acoustics has shown that when any particular musical note, say the middle C of the piano, is sounded on a cornet the particular piano string giving the note will vibrate sympathetically to the sound waves produced by the cornet. This will only take place if the piano wire is of the proper length and is at the requisite tension. Such a piano string is said to be tuned to middle C. The cornet player, by pressing one of the valves of his instrument, can practically cut in a longer section of his

trumpet and produce a lower note. This lower note will be responded to by a longer string on the piano and thus the longer tube of the cornet and the longer string of the piano are practically said to be "in tune."



WIRELESS EXPERIMETAL TRUCK IN THE U. P. YARDS AT OMAHA.

In wireless telegraphy, one of the several methods for "tuning" the sending and receiving apparatus consists of making the length of the sending and receiving wires or antennæ equal, or, more correctly speaking, it consists of making the effective lengths of the wires equal to one another, so that waves given off by a certain length of antennæ wire will, if one may so say, exactly "fit" the other as the waves of sound from the cornet exactly "fitted" the particular piano wire with which it was in tune. The alteration of the effective length of the antennæ in the wireless apparatus may be done by the cutting in or out of a coil of wire or by altering its capacity by the introduction of an electrical condenser.

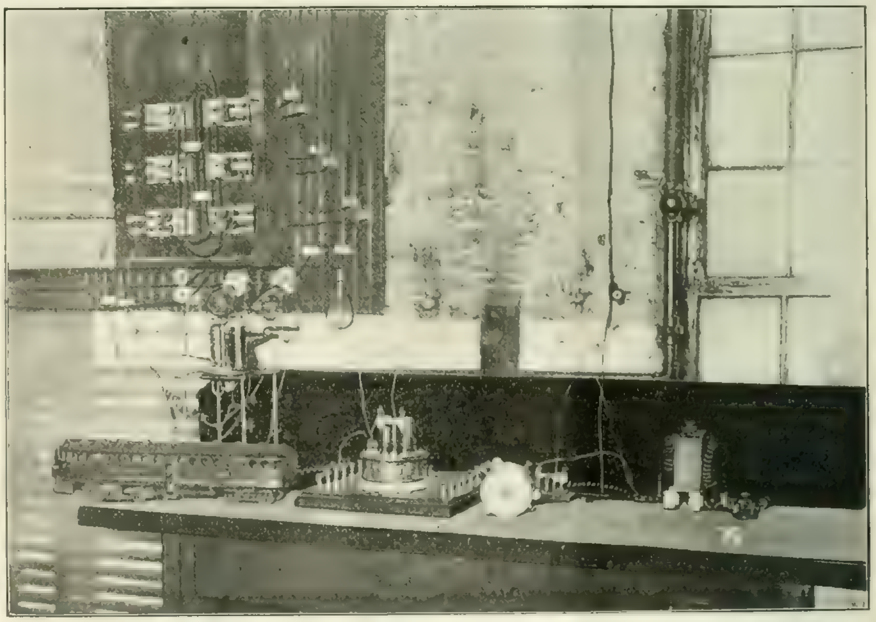
This is only a brief statement of the principle involved in what is called the "tuning" of wireless apparatus. The electrician who has done the work and has so skillfully made an actuality of the wireless truck, Dr. F. H. Millener, has his own methods for producing this effect and of his particular device we cannot now give any details except to say that Dr. Millener calls the invention, which brings all this about, his "selective device." The reason for the name is apparent because it is a device which makes it possible to select any one of a number of pieces of machinery and control that alone without affecting any others. It is a simple device, though, of course, the mechanism is still closely guarded by the inventor. That which is accomplished by the selective device Dr. Millener calls "remote control."

The "selective device" was not the only thing needed by Dr. Millener before he could control the movements of machinery on wheels. He found himself facing the problem of securing a "ground." He overcame this by the invention of what he calls a "traveling ground." This invention makes the "ground" connection constant and unvarying, unbroken by the passage of the wheels of a car or other vehicle over any obstacle that breaks the ground connection. Incidentally, the devising of this "travelling ground" has probably gone a long way toward solving the problem of communication with moving trains or other vehicles, as well as solving the problem of maintaining sufficient control by wireless, over the motive power of an engine or other piece of machinery on wheels.

Under the direction of Mr. W. R. McKeen, Jr., superintendent of motive power and machinery of the Union Pacific, Dr. Millener set about the experiments which have resulted in the "wireless truck." In the little workshop shown in our illustration he has developed and perfected the "selective device," which makes remote control of machinery possible and compels it to do his will without any visible connecting apparatus.

The power for operating the truck is contained in a storage battery which it carries and the wireless equipment was applied for experimental purposes. In order to practically study the whole subject, this truck has been equipped with the necessary receiving wires, or antennæ, and Hertzian electrical waves have been used in connection with a wireless telegraph coherer for making and breaking the circuit between the batteries and the motor on the truck, thus starting and stopping the car.

It is not claimed that this wireless truck is of any immediate practical value of itself in the Union Pacific yards, but the subject is a large one, that of controlling machinery without material contact with any part of it, and the Union Pacific people are making some interesting studies of the subject at the present time. Dr. Millener is now preparing to equip one of the big Union Pacific locomotives in the shop yards with the device. In applying the invention to a machine moved by steam a small electric motor is to be used and so arranged as to respond to the wireless waves thus opening or closing the throttle of the engine.



APPARATUS FOR REMOTE CONTROL OF MACHINERY.
(Sending Instrument Marked X.)

General Correspondence

Bank Firing of Bituminous Coal.

Editor:

There has been much discussion and much has been written concerning nearly every feature of locomotive practice, but the first and by no means the least important step in transforming the energy stored in the fuel into drawbar pull, as well as perhaps the most difficult one to understand, namely, the combustion of coal in the firebox, has received comparatively little attention.

A few years ago, however, it was recognized that with the size of boilers in use, the narrow firebox required a rate of combustion per unit of grate surface altogether too high to be economical. By keeping the entire grate area thickly covered with a glowing mass of burning coal, a furnace temperature sufficiently high could be maintained when an engine was being worked hard to generate the steam required, but to do this a draft strong enough to carry a large part of the more volatile substances of which the coal is composed unconsumed through the flues was necessary.

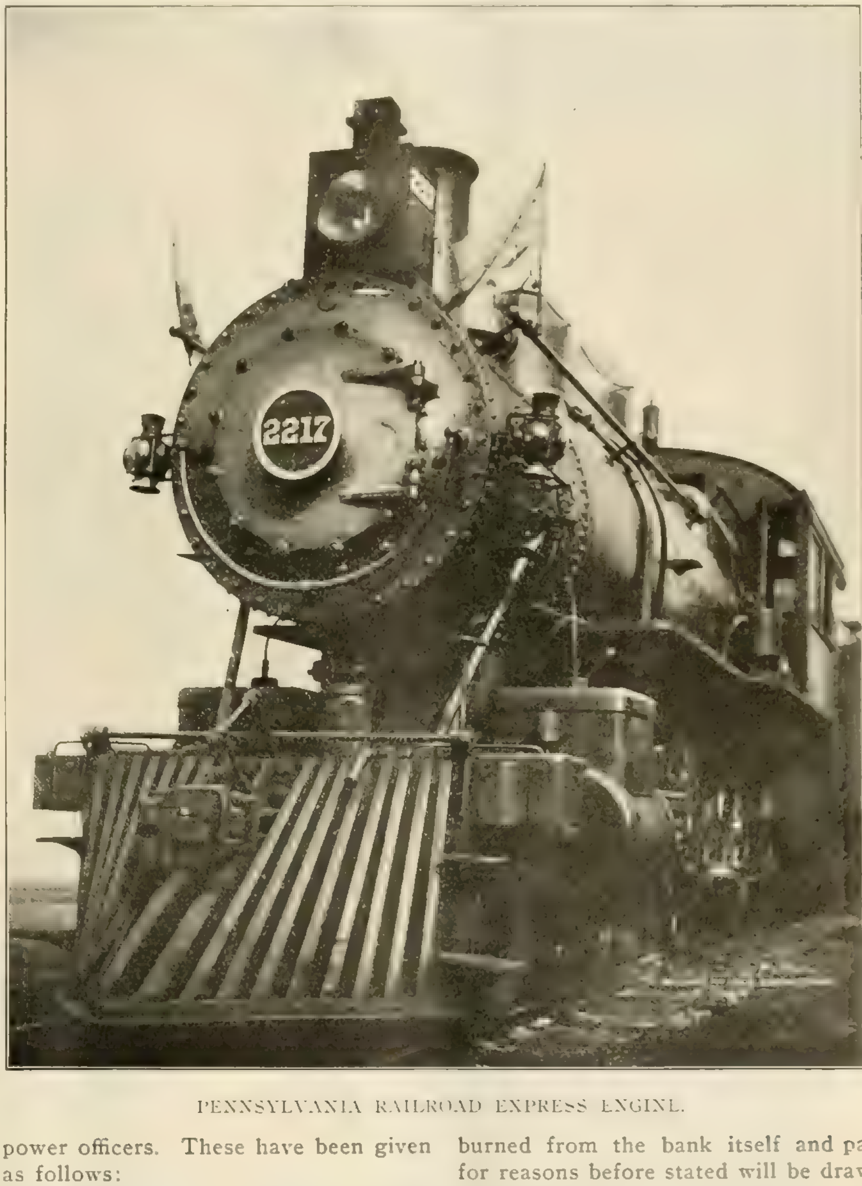
To permit more thorough combustion, wide fireboxes with their larger grate areas were introduced and with them the method known as bank firing has become general. It consists in building, as soon as possible, a bank of coked or nearly coked coal across the back part of the firebox, extending upwards at a sharp angle from the bottom level near to the top level of the firedoor and from there at an angle depending on the way the engine is being worked to an area of level fire at the front of the firebox. Coal is then thrown for the most part just over the top of this bank and allowed to feed forward by the action of the draft and of gravity, assisted greatly at high speeds by the vibration of the engine.

The advantages of this method of firing from the fireman's point of view, briefly stated, are: 1st. The bank can be kept at a low temperature around the door and is a protection from the heat when the firedoor is open. 2nd. Much less work is required to place the coal evenly upon the bank than to spread it over the entire grate area. 3rd. The work is simplified, requiring the same use of judgment to determine the amount of coal needed, but less skill in placing it within the firebox.

The requirements made upon a locomotive are so varied that conditions only approximately correct for the highest economy of its operation can be secured at any one time. Examined from the standpoint of fuel economy, however, this method will be found to provide much more nearly the conditions theoretically necessary for the perfect combustion of coal than the level system commonly advocated by motive power officers. These have been given as follows:

1st. Sufficient but not an excess of air in the combustion chamber. 2nd. A thorough mixing of this air with the fuel gases, which can usually only be done by allowing the air and gas to flow together over the length of the furnace. 3rd. A sufficiently high temperature to insure ignition.

If a bank is built carefully, as already described, enough air will be admitted through it so that the coke of which it should consist will burn rapidly enough to volatilize the hydrocarbons of the coal spread upon it and as no surplus air is admitted at this point, all the heat produced here is available for this work. Part of each fresh supply of fuel added will replace what has burned from the bank itself and part for reasons before stated will be drawn toward the front of the firebox. Here the fire is comparatively thin and a full supply of air is admitted so that the coke, of which the solid part of the coal consists when it reaches this area, burns rapidly, generating intense heat. Over this heated space the hydrocarbons evolved nearer the door, mixed no doubt with a percentage of carbon monoxide formed because enough air was



PENNSYLVANIA RAILROAD EXPRESS ENGINE.

not supplied through the thicker parts of the bank for its complete combustion and with the air admitted at the door must pass, and conditions are thus furnished, as nearly as it is possible to secure them, favorable for their complete transformation into carbon dioxide and water vapor with the consequent production of heat.

In aiding to secure the second of the conditions noted as necessary for perfect combustion; namely, the thorough mixing of the air and the unconsumed furnace gases, the bank performs a service that should not be overlooked. With a fire kept below the level of the door, the air which enters here will pass in a more or less unbroken column to the flue sheet and become only imperfectly mixed with the gases being generated. Upon being obstructed by the back slope of the bank, however, it will be broken into a spray, or at least spread out into a thin sheet, and in this form will become much better mixed with the firebox gases. If we imagine water instead of air as being drawn rapidly into the firebox and the back slope of the bank to be a steel plate strong enough to withstand such a column of water, we can more readily understand this action. A further advantage of the bank in this connection is that the door opening may be partially closed with it if so desired, a means of regulating the amount of air admitted here being thus afforded.

THE CALEDONIAN LAST WINTER.

Upon opening the firedoor to put in coal when a level fire of about the proper thickness is being carried and the engine is working briskly, the firebox will often be found to be clear of smoke and flame, the coals burning incandescent and with every indication of intense heat, and it is on account of this fact, perhaps, that the level fire gets much of its popularity. We should remember, however, that at this time conditions are more favorable to perfect combustion with this system than at any other. The waste has already occurred. Large quantites of hydrocarbons were rapidly distilled from the last supply of coal just after it was put in and carried unconsumed through the stack, especially from the fuel that was spread near the flue sheet. The clouds of smoke given off at this time being indisputable evidence that this is what occurred.

The grate area of wide firebox engines is so large that when an engine is being worked with the throttle partly closed and reverse lever hooked near enough to the center to use what steam is generated economically, it is often impossible to keep an even level fire thin enough to admit the proper amount of air, and even if this could be done the rate of combustion would be so low that a firebox temperature at no time much higher than the igniting point of the gases would result and the temperature would be reduced much below this point by coal added even sparingly and the air admitted at the door independently of the heat loss occasioned by the volatilization of part of the added fuel. The effect of a bank at such times is to restrict the grate area and so compel a rate of combustion at the front end of the firebox rapid enough to produce a margin of temperature above the igniting point of the gases sufficiently large to be less easily destroyed by added fuel or other causes.

Another advantage that bank firing has over the level method is that the puddling effect of throwing coal with considerable force forward into the firebox is avoided. Each lump of coal fired in this way will have a tendency to cool and flatten out any of the fusible impurities of the coal which have been softened by the heat that it may strike, thus aiding in the forming of clinkers. Coal fed upon a bank will alight easier and also usually at a point where the fusible impurites of the coal have not yet become plastic and so cannot be flattened out by its impact. At the front end of the firebox a temperature high enough to reduce part of these substances to gases is maintained and in this form they pass out of the stack with other products of combustion.

This principle of bank firing is by no means new. It is, in fact, essentially the same as the coking system recommended by Watt when steam was first used to pump water from English mines and recognized ever since to be sound in theory, having been superseded by the level or spreading system only in order to get an increased output of steam without regard to economy. Successful mechanical stokers in use on stationary boilers at present, moreover, with scarcely an exception, carry a very similar fire; coal in process of coking in the rear of the furnace and a bright hot fire of coke in front over which the hydrocarbons must pass and where their combustion is completed.

But while this method of firing properly handled is wholy consistent with fuel economy, it must be admitted that it is productive of considerably different temperatures at different parts of the firebox and the claim is often made that this is extremely hard on flues and firebox sheets. Concerning this phase of the subject the writer must at present confess inability to speak with confidence. It can be safely said, however, that the damage so resulting is equally much overestimated, especially by those to whose interest it would be to have failures attributed to such causes rather than to faulty material or workmanship for which they may be responsible and that a practice known to result in a saving both of fuel and labor should be condemned on such a score only after thorough and impartial tests made by those having the most complete knowledge possible of the physical properties of the substances dealt with. We should remember that the number of molecules of water coming in contact with a square inch of the inside of a boiler is many times the number of molecules of heated gas coming in contact with the same space of the firebox side, and considering the quality of the firebox plates as heat conductors, the ability of the water to absorb the heat of the gases and make the temperature of the plates the same as its own correspondingly greater; so that, with proper circulation, it is not probable that the differences of temperature extend to any appreciable depth beneath the surface of the firebox sheets.

R. G. Donaldson.

Fireman Eastern Div. Penna. Lines West.

Allegheny, Pa.

Wide Driving Brake Shoes.

Editor:

Wishing your opinion as to my contention of defect of the Cristy Driver Brake Shoe, I desire to say that shoes are made ½ in. wider than face of driving tire. When in service a short

OH! FOR THE GOOD OLD SUMMER TIME.

time there is a double flange on shoe or ½ in. flange is on outside of shoe, which, after constant use on heavy power on short work, where brake is frequently applied, tire becomes warm, the cast-iron shoe contracts more than the steel tire, consequently shoe adheres to tire after brake is re-

leased with the result of either pulling eye out of shoe or stripping some part of brakes.

I have seen many cases where the engineer would knock the shoe loose from tire with coal pick. There were also a few instances that came under my observation on consolidation engines where brake was released, the shoe would cling to tire, breaking eye in shoe, which got caught between flanges of tires and actually stopped train when pulling out of station. For a shoe to be lifted at least 18 ins. in this way certainly proves adhesion. By cutting ⅜ in. off outside of shoe there would remain sufficient surface to prevent any sharp edge on outside of tire tread forming and reduce repairs to brakes 50 per cent., not mentioning the facts the engineer would be relieved from being continually blamed for improperly handling brakes.

C. B. M.

Chicago, Ill.

FIG. 1. L. & N. W. COAL ENGINE.

FIG. 3. CRANE ENGINE L. & N. W. RY.

Some British Shunting Engines.

Editor:

As a result of the introduction and extended use of eight-coupled mineral engines on the London and North Western Railway, which permits of economies being effected by the haulage of coal in longer and heavier trains, "the 4-ft. 3-in." coal engines shown in Fig. 1, designed by the late Mr. F. W. Webb, have gradually been displaced, as they were deficient in adhesive power. They are still, however, useful within their limits, and Mr. G. Whale, the present chief mechanical engineer at Crewe, converted one experimentally into a saddle tank engine for working short distance mineral traffic and shunting purposes. It proved to be so successful that several of the class have been similarly converted, one of which is shown in Fig. 2. The leading dimensions are practically unchanged: Cylinders, 17 by 24 ins.; diameter of coupled wheels with new tires, 4 ft. 5½ ins.; total wheelbase, 15 ft. 6 ins. Heating surface of boiler: firebox, 94.6 sq. ft.; tubes, 980 sq. ft.; total, 1,074.6 sq. ft. Grate area, 17.1 sq ft. Working pressure, 150 lbs. per sq. in. Capacity of tank, 900 gallons. Weight, in working order, 40 tons 9 cwt. The original weight of these engines as shown in Fig. 1, exclusive of tender, was 29 tons 11 cwt.

Fig. 3 shows one example of half a dozen four-coupled shunting crane engines, the first of which was built in 1892. They have a lifting capacity of about 3 tons. The leading dimensions are as follows Cylinders, 14 by 20 ins.; diameter of coupled wheels, 4 ft. 3 ins., and of trailing wheels, 3 ft. 9 ins.; wheelbase, 14 ft. 9 in. Heating surface: firebox, 28 sq. ft.; tubes, 405 sq ft.; total, 433 sq. ft.; grate area, 11 sq ft. Boiler pressure, 120 lbs. per sq. in. Capacity of tanks, 420 Imperial gallons. Total weight of engine, 32 tons 17 cwt.

Fig. 4 illustrates one of a new class of yard shunting engine recently built at Derby for the Midland Railway. It has: Cylinders, 15 by 22 ins.; diameter of coupled wheels, 3 ft. 9¾ ins.; wheelbase, 7 ft. 6 ins.; length over buffers, 25 ft. 4¾ ins. Boilers: length of barrel, 10 ft. 4 ins.; diameter, 3 ft. 8 ins., containing 141 copper tubes, 10 ft. 5⅜ ins. long by 1¾ ins. outside diameter. Firebox shell, 4 ft. long by 3 ft. 10 ins. wide. Heating surface: firebox, 64 sq. ft., tubes, 697 sq. ft., total, 761 sq. ft.; grate area, 10.5 sq. ft. Working pressure, 160 lbs. per sq. in. Capacity of tanks, 650 Imperial gallons, and of bunker, 32 tons 16 cwt. The motion is worked by Walschaerts gear.

Ridgway, England. A. R. BELL.

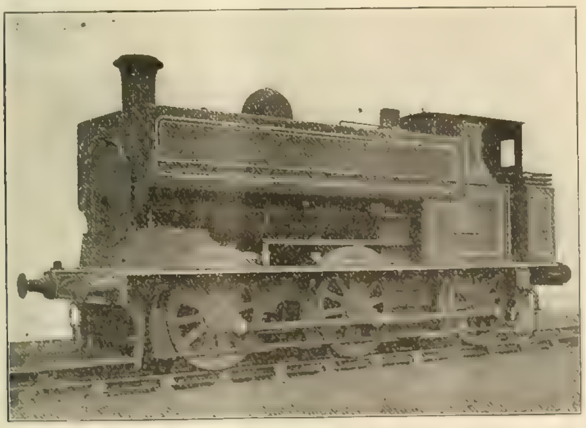


FIG. 2. CONVERTED ENGINE L. & N. W. RY.

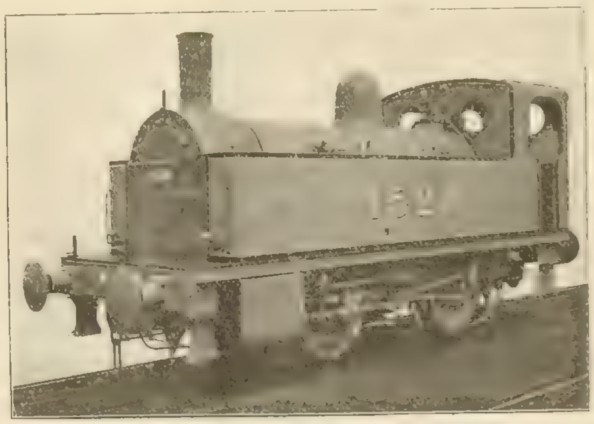


FIG. 4. YARD ENGINE ON THE MIDLAND.

Crude Oil Welds.

Editor:

I noticed in the May issue of RAILWAY AND LOCOMOTIVE ENGINEERING, page 194, an article from Master Mechanic D. P. Kellog, of the Southern Pacific, at Los Angeles, Cal., claiming he is the originator of the Crude Oil Weld and that I had written to Mr. W. F. Merry, of the Tucson shops for information regarding the Crude Oil Weld.

This is very true; but, before I wrote to Mr. Merry, we had successfully welded 57 frames on locomotives with crude oil, and I would not have written to Mr. Merry if his blacksmith foreman had not first written to our blacksmith foreman for "information on Crude Oil Welding."

Some time after we had sent Mr. Merry's blacksmith foreman detailed information and sketches on Crude Oil Welding, I wrote to several foremen (one of whom was Mr. Merry) asking them for their opinion on Crude Oil Welding. Now, I did not ask this for information, but simply wanted it to present at the International Railway General Foremen's Association convention in 1906.

Our own mechanical experience has taught us how to successfully weld locomotive frames with crude oil, and I beg to advise Mr. Kellog that we did not derive this method from any person or paper.

If Mr. Kellog is the originator of Crude Oil Welding since June, 1899, I wish to give him the credit; but, as mentioned before, we did not derive our experience from Mr. Kellog, but by our own efforts and mechanical experience. C. H. VOGES,

General Foreman, Big Four Shops.

Bellefontaine, O.

Don't Railroad at Home.

Editor:

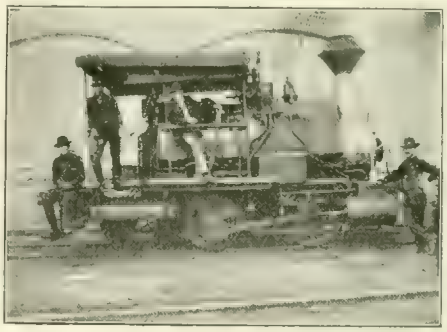
I want space enough in your valuable paper to say this much to railroad men: Don't poison the little ones' brains at home by continually talking railroading, running trains, switching cars and condemning the officials at home.

Hundreds of railroad men render themselves less efficient during working hours and often shorten their years by the senseless habit of taking their business affairs home with them. Some of them even make their railroading the chief topic for conversation at the dinner table or under the evening lamp, while others brood over it, or worry over it, in silence. If anything, however, the latter is the worse of the two. There is scarcely a more reprehensible practice; it is wrong in every way. No railroad man with a continuous responsibility on his hands has a right to abuse himself in this manner, and the practice is also an outrage on his family. It gives to his home an atmosphere of railroading and practically transforms the dining room, the parlor, or the porch into a roundhouse, call boys' office or a switchyard. It deprives the man himself of the mental rest and invigoration which naturally comes from a new train of thought. Nor is it of any use, for, generally speaking, the railroad man's family are not sufficiently versed in the details of railroading to assist him by their advice.

If we read the biographies of men who have been captains and leaders in commercial life we will find that this had not been their practice. On the contrary, they have invariably confined their business exclusively to business hours. Many of them have made it an invariable rule that after closing their office doors they will not under any ordinary circumstances consider a business matter until they return to the office the following morning, never allowing appointments of this kind to be made at their homes. There is nothing gained by the discussion of railroad problems at home. Don't do it. My father being a locomotive engineer, I heard my share of it from the cradle to manhood. I got so completely wrapped up in it that as soon as I got old enough I went firing and worked my way up to running an engine. I ran on the Bessemer & Lake Erie for three years, but, happy to say, to-day I am out of it and in business for myself.

F. A. BAKER.

Meadville, Pa.



OIL BURNING SWITCHER.

Oil Burning Switcher.

Editor:

This photograph is a type of one of the early oil-burners of the Southern Pacific system, and is used to do the shop switching and handle dead engines in and about the roundhouse at the Oakland shops, California.

Its short wheel base allows it to handle almost any of the engines on the turntable, and it is considered a valuable piece of machinery. The water tank is on top of the boiler, the oil tank is on the left side and the firing valve, atomizer, tank heater and superheater valves are placed handy to the engineer so that he can do his own firing.

The engine is equipped with a Westinghouse 8-in. pump, straight air and pneumatic sanders. There is no need of a headlight, for this engine works days only. The crew consists of an engineer, who in the picture is standing at the head end, leading switcher in the cab and his helper on the back bumper beam. The caller Pongo happened along at the time and wanted his picture "took."

Fruitvale, Cal. W. UPDEGRAFF.

What Should a Young Fireman Know?

Editor:

In the May issue of RAILWAY AND LOCOMOTIVE ENGINEERING, under the article headed "What Should a Young Fireman Know?" you request the opinion of your readers on this subject, especially traveling engineers. This is a matter I have given some thought to, and as this opportunity affords me the privilege of expressing myself, I take pleasure in submitting the following:

I think a man to make a good fireman should be strictly moral in every sense. He should not drink, swear, use tobacco, nor permit himself to frequent questionable places. The absence of these habits will supplement a man's value in every instance. So many of our firemen neglect the law of morality. While running an engine I had an opportunity of observing the contrast in firemen that respected their moral natures, and those that did not. The fireman that did not partake of any of the vices just mentioned was a man that was always awake, always watchful, and never had to be told anything twice. His ability in the performance of his manifold duties was such that he was irreproachable. In fact, he was a man that one could place that confidence in which should exist between every engineer and fireman. While on the other hand, the fireman that was addicted to these habits was a man that remained luke-warm; never seemed to progress in his work as he should, and did all things about half way. Do not construe me as meaning this to always be the case, but on a general average it is.

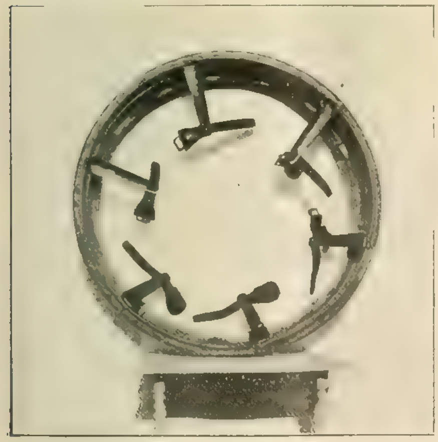
A fireman should keep himself in readiness while on duty to go whenever called upon. If a regular man, he should always protect his run and never lay off after being called. In short, no fireman should ever lay off after being called, for it not only reflects on the individual, but places the roundhouse foreman at a disadvantage. After being called he should get to his engine at whatever time the road he is on requires. I might say that punctuality is one of the best recommendations that a fireman could have. Not only in getting to his engine on time, but in the performance of all his work. He should acquire a good system of doing his work, and then practice it continually. Say a system something like this: (1) After being called, come to the roundhouse where the board is kept, and ascertain what engine and engineer you are going out with. (2) Change your clothes for working garb, and put them neatly in the seat box. Be sure that seat box is

clean; also engineer's, if he has one. (3) Sweep out deck, including in front of both engineer's and fireman's seat boxes. A clean deck always speaks for itself. (4) See that all necessary supplies are on engine. (5) Examine all lights and see that they are trimmed, filled and in burning condition. (Might say as a word of caution, never allow your cab lights to smoke, this is bad taste.) A wide-awake fireman, after completing his regular routine of work, will then proffer his help to the engineer. This shows the right disposition and spirit of the individual, and paves the way to a harmonious feeling between himself and the engineer. Every engineer appreciates this willingness of the fireman, whether he accepts his proffer or not.

A fireman in freight service, after engine is attached to train, will get his fire well bedded before starting, as at the time while engine is getting train under way is the hardest time to keep maximum pressure of steam. A fire can be very easily spoiled at this time, if one is not careful.

Never allow coal to accumulate on the deck. Keep the broom sitting in a convenient place, and after every two or three fires sweep out deck. If this is made a practice of, it will come as natural to sweep deck at these intervals as to put in a fire when one is needed.

Some firemen after firing a certain length of time allow a feeling of egotism to creep in and take possession of them. They get so that they know more than



TIRE READY TO STRAP ON.

the engineer, and turn a deaf ear to all his instructions, or have a disposition to argue with him. I want to say right here that when a fireman reaches this place in his experience he is no longer a useful man for the company, and the sooner he is gotten rid of the better it will be for all concerned. The fireman that keeps himself humble and ready to take advice, and allows no prejudices to harbor within him, is the man that goes to the top of the ladder.

If a new theory is advanced, train yourself to accept it upon the terms it is introduced, and give it a fair and impartial trial. I have heard firemen make all kinds of fun of a new idea that was being introduced, and after a thorough trial would have to admit it was O. K. For example: I recall the time the one-shovel method of firing was first introduced on the road where I was firing, as an innovation. Very nearly every fireman on the road took an adverse view of it and condemned it before trying. The road foreman of engines had a hard time overcoming the prejudice that had arisen, and only did after having one or two traveling firemen ride with the boys and instruct them, and discharged one fireman who absolutely refused to try it. The boys seemed to think they had to use only one shovel of coal for every fire, while the theory the management was trying to advance was "light firing." By the foregoing example I wish to convey the thought of how much better it would have been if the firemen had taken a favorable view of the matter, instead of as they did, for, as it was finally, they had to concede it was the better way.

Another commendable trait of a good fireman is that of not talking too much to the engineer. Very few engineers like to be bothered with a fireman that is continually talking about something and attracting his attention from his work. It is all right to talk about matters that pertain to one's duty, but other than this I would advise them to abstain from it. Do not cultivate the habit of sleeping on the engine. This is a bad practice, and one that is likely to get you into trouble if persisted in. Keep the oil cans free from grease and dirt. Immediately after engineer is through oiling, see that hand oiler is refilled and put in its proper place. Acquaint yourself with all the different signals that are in vogue. While switching, if signals are given on the fireman's side, give the same signal to the engineer with your hand, if in day time; also speak it in an audible voice. If you are firing a pool engine, when nearing the end of your trip, begin to get things in readiness to leave engine, such as wiping off oil cans and putting them in a handy place together. Before leaving engine blow out all lights and bring in classification signals, which is the custom on our road. Leave your engine in a good sanitary condition and the next man that goes out on her cannot help but speak well of you.

If a fireman will adhere to the outline herein given he need nor fear that his services will not be satisfactory.

M. E. Lewis,
So. Ind. Ry. Traveling Engineer.

Automobile on Rails.

Editor:

I am the inventor of a supplementary tire made and designed to fit an automobile rubber tire so that the car can be used on railroads as an inspection car for road supervisors, bridge builders, etc. The railroad physician could also use it with advantage in case of emergency.

The tire is strapped on to the spokes of the wheel and this can be done in about 20 minutes and without letting the air out of the rubber tires. This supplementary tires can be removed in about 15 minutes. I have tested them and they have given fine service. I made a speed of 32 miles

AUTO AS A RAILROAD INSPECTION CAR.

an hour, fast as the car would run. My tires have to be made to suit the various sizes of automobile wheels in use. I enclose photograph of my tire and of an automobile so equipped and on a railroad track. The device has been patented.

Chas. H. Goodman.

Bucyrus, Ohio.

"Elevated" Pits in the Roundhouse.

Editor:

The feasibility and the adaptability of an elevated pit in an engine house has not received any consideration in the designing and construction of modern roundhouses, yet the importance of them in an engine house should be apparent to all. By an elevated pit in an engine house is meant that the rails should be supported by iron posts similar to those used in the construction of elevated ash pits, or cinder pits, instead of laying the rails on a stone, or concrete wall.

The elevated pit should extend outside of the rails about four feet and be not less than three feet in depth. A few pits of this kind in a roundhouse could be used most advantageously in effecting repairs to tender trucks. Then it would not be necessary for the man doing repairs to stand on his head, so to speak, or be crouched so that he is not capable of performing good and effective work. That is, when the work is on the outside of the truck.

Such pits are almost indispensable in effecting some repairs to tender truck, especially diamond truck, as frequently

the engine has to be returned to the ash pit to èxecute the work, and this adds more fuel to the fire, as the ash pit is generally congested. Yet this has to be done occasionally in order to meet the exigencies of the service. Sometimes engines come to the house and they are needed for immediate use and there is found an arch bar bolt broken, on a tender truck. Time will not permit the removing of the truck from under the tank and the only remedy left is to cut the head of the bolt and return her to the ash pit to remove the broken bolt and apply another by putting it in from the bottom and putting the nuts on the top of the arch bar bolt.

This not only entails delay on the ash pit, but it also retards the progress of the running repairs to the same engine; while if an elevated pit in the house was available all the work could be done in the regular course and the ash pit would not be disturbed, and consequently the engine would be dispatched back into the service more quickly—an important feature to be considered in busy times.

An elevated pit would be very useful in the taking down driver box wedges and lining them. There would be no projecting wall to interfere with the dropping the wedges and replacing them. Then, too, it would be more convenient to go beneath the engine, as you could go between the posts and not be obliged to go to the end of them and then come to the place where the work has to be done. Such pits are feasible and would be utilized daily and duly appreciated by the roundhouse force.

Some may advance the objection to these elevated pits being dangerous. Granted. So are all pits. But the present roundhouses are so thoroughly and fully illuminated that it would require but a brief period to educate the men as to the location of such pits.

JAS. FRANCIS.

Carbondale, Penn.

Repairing Cracked Bell.

Editor:

Did you ever hear an engineer complain about his engine bell being cracked and sounding like a tin pan?

Most engineers take great pride in their bells and when one gets cracked, they generally say something about it. Here is a little trick that I have seen tried that saves the tone of the bell, providing the crack in the bell is not too large. The cause of the flat sound in a cracked bell is the two sides not vibrating in unison with each other. To overcome this and yet not to interfere with the vibrations will generally restore the original tone.

If the crack isn't too big take an ordinary hack saw and put in 2 blades and saw the bell following the crack. By doing this, you cause an opening wide enough to allow the bell to vibrate, but the two sides do not touch and so stop the vibrations. Of course, a person can't expect to saw a bell nearly in two and still save the tone; there is a limit to all things. However, when the crack is small, this trick can be tried and good results generally follow.

H. L. BURRHUS.

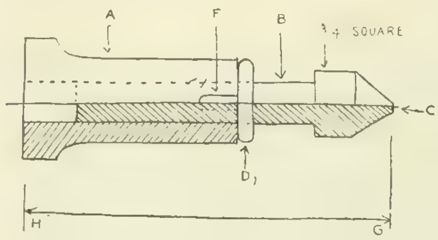
Hornell, N. Y

Device for Placing Valve Facer.

Editor:

While being foreman for the Illinois Central I had a convenient tool made for placing in position the valve facing machine, without the use of calipers or measurement. There were four of these tools to make a set. Anyone is at liberty to make the tool.

The pieces, four in all, consist of the



DEVICE FOR VALVE FACER.

foot-piece, A, with a hole through same ¾ in. in diameter. The sliding bar, B, is made of steel and with the point C flat, say ⅛ in. in diameter. D is a ¼ in. steel pin driven in B to stay. In the top of A is a slot, F, across the diameter to receive pins, D. The operation is as follows: Place the tools on the cylinder, one in each corner outside of the valve face proper, and where steam chest joins to cylinder, raise up the sliding bars so that the pins, D, are resting on top of A crosswise with the slots.

Now place the machine on top of points, C, and run up the stud nuts under the machine with the same tension; then tighten up all stud nuts on top of the machine; you will now find the machine set mechanically correct with cylinder, regardless of valve face being unevenly worn. To remove the tools, turn the sliding bars, B, one quarter of a turn, so that the pins, D, will drop in slots, F, and the tools can be taken out. When making the tools, the entire height from H to G must be the same, when the pins are resting on top of A. The height of the tool depends on length of tool and tool holder on the machine. We find it a very convenient and useful shop appliance.

C. WIEHELMSEN,
Master Mechanic K. & E. R. R.

Kentwood, La.

A. S. M. E.

Editor:

The American Society of Mechanical Engineers is a very august and important body in the eyes of those who don't know, and is keeping up its reputation as a notable member of the Circumlocution Office, or how not to do it. I believe that I have taken occasion before to allude to the advertising character of many of its papers and the demoralized condition of the bound volumes of its technical literature, but really in its old home it was a very decent sort of a place to drop in and write a letter or read if you happened to want to read what they had. But now that they have moved into their new million dollar building all the old homeness and convenience seems to have disappeared; the attendants that we once knew are gone and in their place we have a corps of flunkies who are not always as courteous as they might be.

As a sample of circumlocution, take this: A member wanted to write a hasty note the other evening, and though he was directed to a writing room on the ground floor, there were tables and chairs but neither paper nor pens nor ink nor stamps were to be had, so he went to a neighboring hotel. Expressing his opinion in the matter later, the janitor kindly offered to let him write in his room if he wanted to. This was very kind, but it seemed a little incongruous for a member of a big club or society that occupies a building like that to be obliged to go to the janitor and ask as a personal favor to be allowed to go into his room if he wants to write a letter.

It isn't because they don't know of it, for one of the managers said that the matter had been up, but not yet decided. You see, each society is supposed to supply its own stationery, and I suppose each is afraid the other will use what it supplies, and so each refrains from a five dollar appropriation that will help the thing along. The fact is it looks as though the thing and the combination was too big to be of much personal benefit to the members, for they now apparently hold stock in a corporation instead of being members of a society. When the Civil Engineers voted not to go into the combination and sink their identity they were criticised, and severely, for their desire for isolation. Some called it snobbishness, but in the light of current events they are to be congratulated on their foresight and wisdom.

GEO. L. FOWLER.

New York, N. Y.

Canada has the largest wheat fields in the world, 300 by 900 miles.

Not Generally Known.

Editor:

Everybody knows of the existence of certain fast trains in the United States, but there are many trains which, unknown to most people, make notably fast runs. The Pennsylvania Special is known to everyone as one of the world's fastest long distance trains, with an average speed of 51.6 miles an hour. Few people know, however, that the time of this train over the 194 mile stretch from Jersey City to Harrisburg is only 196 minutes—perhaps the fastest run in the world, for the distance. One French express does slightly better than this on a 181 mile run, the time being 180 minutes.

The Union Pacific's Los Angeles Limited (eastbound), although its average speed is only 34.3 miles an hour, runs from Cheyenne to Omaha, 516 miles, in 11 hours 59 minutes, an average of 43 miles an hour, including 8 stops. This is a very good performance, considering the long distance. The Overland Limited does almost as well—12 hours 15 minutes—over the same stretch.

The South is supposed to have no fast trains worthy of mention, but a notable exception is the Atlantic Coast Line's "Florida Special," which runs from Jersey City to St. Augustine, Fla., 1,403 miles, in 27 hours 10 minutes an average speed of 38.3 miles an hour. This speed compares favorably with that of the Pennsylvania's 24-hour Chicago trains, and is, moreover, maintained for a greater distance.

There are a great number of shorter runs which do not receive much consideration. The New Haven road has six trains that cover the distance between New Haven and Providence, 114 miles, in 131 minutes, or at 52.2 miles an hour, excluding the stop at New London. Numerous trains on the Pennsylvania make the 85 mile run between Jersey City and North Philadelphia in 100 minutes and less; the Pennsylvania Special does it in 83 minutes, or 61.4 miles an hour. On the Philadelphia & Reading, the 57 miles between Bound Brook, N. J., and Wayne Junction are covered in 61 minutes—56.1 miles an hour. The "Florida Special," mentioned above, runs from Charleston to Savannah, 115 miles, in 130 minutes, or at 53.1 miles an hour.

Andrew Linn Bostwick.

New Haven, Conn.

Electrification of Steam Roads.

Editor:

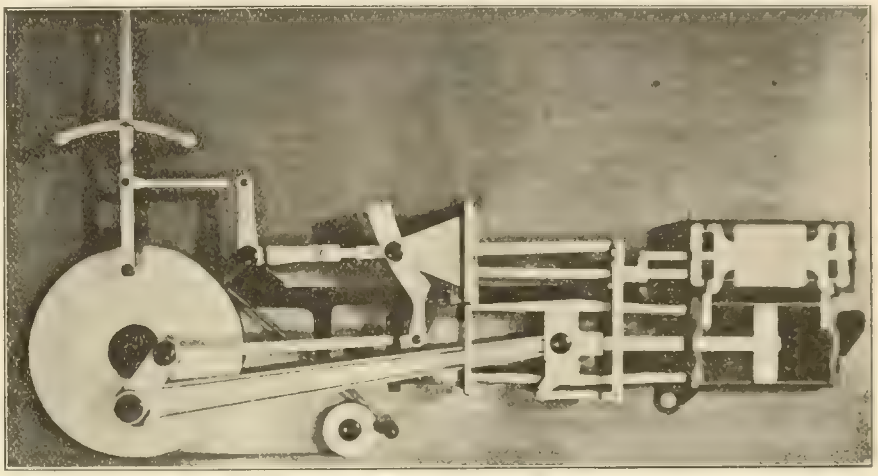
With the advent of the electric locomotive, many of the enthusiasts in the electrical field were very sanguine in their predictions that the relegation of the steam locomotive to the scrap heap, or slightly better, its subordination to the menial duty of acting as a switcher in yard service, was only a matter of time. Despite all that has been urged against Stephenson's King of machines, the snorting monster with its heart of fire is here yet, and is here to stay.

What is said is intended in no way to detract from electric power as applied to traction, for it has reached a point where it is a potent factor in our modern civilization. At the time that the telephone sprang into use, the intense popular favor accorded it seemed to many to be a positive indication that the days of the old Morse clicker were numbered, yet to-day both of these exceedingly, I might say indispensable, utilities are working harmoniously side by side, each having its own particular sphere of usefulness. It seems to me it is the same way with the steam locomotive and its formidable competitor, the electric locomotive.

There is one particular case in which the electric locomotive should by all means take precedence over its competitor, and that is in tunnel work, especially where the tunnel is of four or five miles in length and the traffic is heavy. In several instances in this country electric power has taken the place of steam power for this particular class of service.

It is well known that the conditions in a tunnel of any considerable length are very poor in regard to the matter of ventilation, good air and light enough to render the use of visual signals both reliable and effective. It is true, the torpedo is an old and trusted friend, but the use of the torpedo should be restricted to cases where, owing to temporary conditions, the visual signal cannot be used effectively. The toleration of a set of permanent conditions that make the torpedo the principal safeguard against wreck and disaster, is a positive indication that the factor of safety is far below the standard that it shouid occupy. Many accidents that have already been recorded go to show that the visual signal is far more reliable and trustworthy than the audible signal. An old sage put the matter tersely when he remarked, "An eye can discover more truth than two ears." Now with the ordinary steam operation in tunnels the smoke more or less completely interferes with the successful operation of any system of visual signals; this has been sadly verified only too often.

No successful illumination of a tunnel can be carried out in the presence of smoke and steam; the unburned carbon in the smoke, popularly known as soot, in the presence of moisture, and also in the presence of the oil that is carried out in the exhaust, serves to give lamp bulbs an opaque coating that renders the source of light worthless. There is, however, a more serious proposition to deal with; all bituminous coal contains a very considerable sulphur content, and it may interest the non-technical reader to know that sulphur is the base of oil of vitriol or sulphuric acid, which has the formula $H_2 S O_4$, and that the conditions from the locomotive furnace to the top of the stack are practicaly the same as they are in the acid works where this acid is produced on a commercial scale. When sulphur burns it combines with the oxygen of the air just as the carbon of the coal does, the compound formed being sulphur dioxide, $S O_2$; this compound in the presence of the steam and moisture becomes hydrated or takes up water forming sulphurous acid, which in the dilute state, while it is inactive on lead, it is exceedingly corrosive in regard to its effect on iron and steel. It is without any doubt highly injurious to paint and varnish.



N. Y. C. APPRENTICES' SCHOOL MODEL OF WALSCHAERTS GEAR.

Under the conditions of an atmosphere impregnated with steam, dampness and sulphuric acid, standard steel rails are found to deteriorate very rapidly, the average life being about four years, the deterioration being due to the oxidizing influence at work, as

the same rails under the same service out of doors in the open air last about twice as long. When the expense for material for renewals is considered, together with the labor item, in connection with same, it is readily apparent that such conditions do not conduce to either safety or economy. With the elimination of smoke and steam, and the introduction of standard visual signals of the automatic type, the tunnel would be in no way very different from the same length of track outside, and its capacity for traffic might be largely increased. Good illumination, which would be possible under the changed conditions, might have very much to do with increasing passenger traffic, and this is always desired. Overhead construction in a tunnel, if practical, would seem to possess several distinct advantages, getting the source of power and light up out of the way and to a place where such equipment would not have to be disturbed when the track required repairs either of a minor or extensive character.

It has without doubt occurred to all thinking railroad presidents that the electric system is the ideal thing for this particular class of service, but we have to remember that all radical changes, such as the abolition of grade crossings, etc., cost large sums, business depression is very marked at present and the Interstate Commerce Commission, like a stern parent, has a heavy hand on the shoulder of the railroad president. All persons who have a really progressive spirit would like to note the installation of a system that would have the triple effect of increasing the net earnings of the carrier, promoting the safety of the travelling public, and at the same time lessening the drudgery of the employee, and enabling him to do his duty under less trying conditions, which always means work of a higher order.

The second scheme for using the electric locomotive under special conditions was suggested to the writer by reading a short article in a recent number of the *Western Electrician*. It is, perhaps, not generally known that an electric motor car running down hill with its motors reversed can be made to draw another car of similar construction up hill, neither car being in connection with the power station.

The writer read an account of this being done in Cleveland, Ohio, by the Brush Electric Co. for a demonstration fifteen or eighteen years ago, and had forgotten the incident until its recollection was revived by reading the notice mentioned above. Such a scheme is not used on street railway lines, as is undoubtedly introduces complication, but it has been done and can be done again, and the idea of one train descending a heavy grade and helping another train to ascend at the same time by means of an invisible rope is something that appeals to the Superintendent of Motive Power with a good deal of force.

F. H. Reardon.

North Adams, Mass.

Prosperity of Galveston.

Editor:

In all your travels on the American and European continents, and your magnificent write-ups of railroading in both countries, you have shown some stupendous undertakings; even how the iron horse penetrates the Alps, and with the speed of Tam o' Shanter's Meg you have shown the "Flying Scotsman" crossing the straths and moors of "Bonnie Scotland." You have pictured the Irish mail thundering from out the shadows of Slieve-na-Mon and winding through the fens along the Lakes of Killarney and casting its phantom shadows beneath the waters of

"Glendalough, whose gloomy shore
Skylark never warbled o'er,"

but you have never written a word about the great railway terminal and seaport of the Southwest: Galveston.

Soon after the great storm of 1900, when Galveston's population was reduced 10,000 in a few hours by the combined horrors of a hurricane and tidal wave, making the city a vast cemetery and consecrating it as holy ground, the world, the millionaire and the working man, joined hands and hearts.

"For a city touched with sorrow
Made all the world akin."

Money, supplies and clothing began to come in; physicians and nurses came as volunteers; the railroads, ever ready to assist when needed, handled special trains of supplies free of charge; there were no special rates and no rebating. They did not want money, they wanted to aid the stricken city and its people. When the wreckage was cleared away there was a family gathering, and it was decided to rebuild a regenerated city.

The road on which the writer is employed has recently entered this city and has expended to date about $1,000,000 on terminal improvements. They have put down 50 miles of tracks, contemplate extensive docks and wharves, all of which will cost several million dollars. The pioneer railway on this island, The Galveston, Houston & Henderson Railway, built "befo' de wa'," is only 50 miles long, running from this city to Houston, and is used jointly for its own business, The International & Great Northern, and the Missouri, Kansas & Texas Railways making it a busy piece of railroad. The Gulf, Colorado & Santa Fe, built originally by Galvestonian and Texas capital, was purchased some years ago by The Atchison, Topeka & Santa Fe.

The Southern Pacific, which also crosses the continent, has extensive terminal and docks here, also grain elevators for storage of several million bushels of grain. They have a regular line of steamers plying between this port and New York. Their freight sheds were built by the acre. Everything is most modern; electric motors the power. Their wharves were partly built before the great storm of 1900; their financial loss was heavy. They started immediately to repair the damage and complete the improvements planned by Mr. Huntington, all of which cost several million dollars. The Galveston Wharf Company, a chartered corporation, controlled all the wharfage and tracks on the bay front prior to the coming of the railways. They own about 200 miles of trackage built on their own property. Prior to this season they did not own any engines; the different railroads furnished the engines and crews. They now own eight modern switch engines and are handling the business with their own power. They also own several grain elevators. The locomotive has grown with the growth of business from the little 4-wheel saddle tank switch engine to the modern consolidation.

The following is the tonnage handled by the terminals and port during 1907, as shown by the report compiled by Galveston *Daily News*:

During the year 1907, 413 foreign vessels with a net tonnage of 1,009,317 entered the port of Galveston, and 533 vessels with a net tonnage of 1,268,297 cleared the port; 457 coastwise vessels with a tonnage of 1,271,067 entered, and 320 vessels with a tonnage of 856,500 cleared. Just imagine the number of engines required to handle this vast tonnage, the number of men required to take care of this enormous business in all departments of railroad and ocean service. The value of cotton and cotton products exported through the port in 1907 was $175,000,000; other exports to the value of $41,436,831. While these figures may not be interesting they show the enormity of the railroad and ocean traffic entering the terminal and port, making Galveston the second in importance in export business in this country. The railway improvements during the year amounted to a million and a quarter dollars. The total number of loaded cars handled in the railroad yards was 167,011. In addition to this great traffic and expenditure of wealth, Galveston spent during the year in municipal improvements nearly $2,000,000. This vast wealth passing through the banks of the city makes it one of the strongest financial centers in this country.

All this has an important bearing on the subject matter filling the pages of Railway and Locomotive Engineering. It affects the builder, the operator and the repairer of the locomotive and the cars, and every man in the railway service.

Jas. McDonough.

Galveston, Texas.

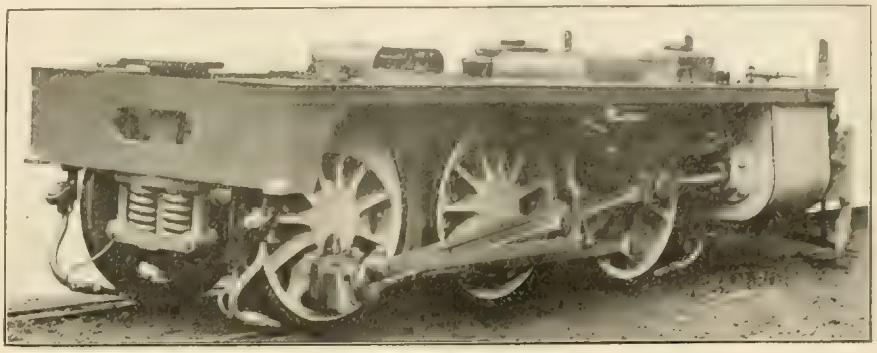
English Fairlie Engine for Burma.

Our illustration shows what may be called a modified Fairlie type of locomotive, built for the Burmese railway system, which is one meter gauge, that is 39.37 inches. The engines, for three of them have been shipped to India, were built by the Vulcan Foundry Company, L't'd, of Newton-le-Willows, England. The engines have cylinders 14 x 20 ins. and 39 in. driving wheels. The tractive effort of one of these "Fairlies" is about 28,940 lbs.

They are intended for working the traffic over the gradients of the system, where the line crosses the celebrated Zibingyi Ghat. The two boilers have each Belpaire fireboxes, and the centrally placed cab is of course arranged for the working of the machine as a unit, as electricians would say. The maximum grade to be encountered is 1 in 25 and there are a number of curves of 300 ft. radius.

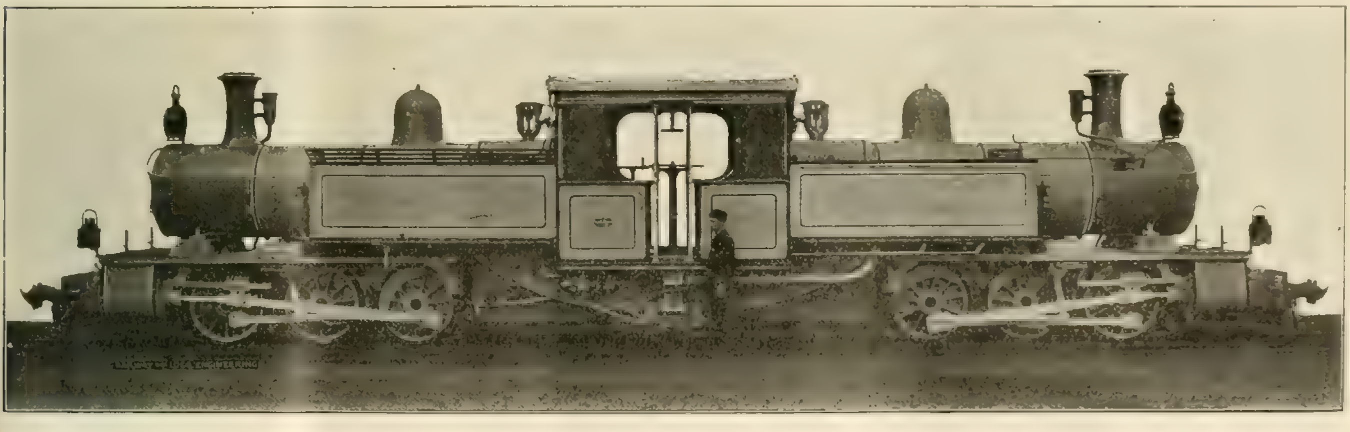
The engine weighs in working order 60½ long tons, and all this weight is carried on the twelve driving wheels. The engines are intended for helper service and carry 2½ tons (long) of fuel and 500 imperial gallons of water. The Joy valve gear is used to actuate the ordinary Richardson type of balanced slide valve. The driving wheels are arranged in two groups, the wheel base of each group being 7 ft. 7 ins. long. The total wheel base is 35 ft. 7½ ins., and this leaves 28 ft. 0½ in. between the centres of the inside pairs of drivers. The arrangement somewhat resembles one of our cars mounted on a pair of six-wheel trucks. The driving wheels of this engine, as a matter of fact, are arranged in two bogies or trucks, which are capable of turning about the smoke box supports in order to accommodate themselves to curves.

The boilers, however, are carried by the bogies upon sliding supports at the back of the truck, the boilers and fireboxes are held stiffly together by means of a pair of heavy plate frames. The lower edge of one of these plates may be seen with curved outline below the deck plate. The whole thus forms a sort of continuous girder between the points of support. The heating surface in the boiler amounts to 1,398 sq. ft., made up of 138 in the fireboxes, 128 in the Drummond water tubes in the fireboxes, and 1,132 sq. ft. in the tubes. The area of the grates is 26 sq. ft. giving a ratio of about 53.8. The boilers are 3 ft. 6 ins. in diameter and each is 8 ft. 5 ins. long. The plates are ½ in. thick and the working pressure is 180 lbs.



ONE OF THE FAIRLIE DRIVING TRUCKS

The firebox, which is of the Belpaire type, is made of copper plates ½ in. thick, with a ⅞ in. tube sheet. Each box is 3 ft. 10⅝ ins. long inside, measured at the top, and 3 ft. 1 in. wide. The depth at the front is 5 ft. 0¼ ins., and 4 ft. 0⅞ ins. at the back. There are a total of 304 tubes, each with an outside diameter of 1⅝ ins., and 8 ft. 9 in. long.



VULCAN FAIRLIE ENGINE FOR BURMA.

The engine is fitted with steam reversing gears, Hornish mechanical boiler cleaners, No. 7 injectors, sight feed lubricators, steam sanders, and cylinder lubricators. The Meyer counter-pressure brake is used in descending steep inclines, while the hand and steam brake are for ordinary use. The Vacuum brake is used throughout the train. The Fairlie type of engine usually presents a more or less "complicated" appearance, but the design before us has been worked out in accordance [illegible] appearance.

Life Savers.

The dedication of the [illegible] of the Locomotive Engine, [illegible] reads:

"Dedicated with profound [illegible] to George Westinghouse, the Guardian of Railway Men, and the preserver of the Traveling Public, whose Great Invention of the Automatic Air Brake has preserved more human lives than any military tyrant ever succeeded in destroying."

A eulogist of Lord Lister says: "Through his scientific discoveries he has saved more lives than Napoleon took in all his wars. No small achievement this, and one for which the respect of every living being, the love of his friends and relations, the honors and decorations of a dozen universities and societies, are but small recompense. His discovery of the famous antiseptic treatment is just over 40 years old, and before then it is estimated that nearly 50 per cent. of surgical operations proved fatal owing to septic poisoning. Lord Lister was created a peer 11 years ago, when he received congratulations from practically every country in the world, so universal is his fame."

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Railroad Mechanical Conventions.

There are many hundreds of technical organizations, of a voluntary character on the American Continent, whose purpose is disseminating information concerning the business in which the members may be engaged, or to make the business done by the members more profitable to their employers. This description may be accepted as applying in the railroad world to all technical societies and clubs ranging from the American Society of Civil Engineers, the American Railway Association, all the mechanical associations and all the railroad clubs. The story is told that a civil engineer who had an aptitude for writing concerning his business and passed many pleasant hours inditing articles for various technical journals, was offered and accepted the position of managing editor of a technical weekly. The first two or three numbers were objects of joy to the new editor. He kept hugging himself about his good fortune in securing, at a high salary, work that he had been accustomed to perform as amusement. When four or five numbers had been made up largely from notes on experience of the editor, he began to realize that his fund of material was running short. In a couple of months he was suffering acutely from the condition that his friends described as being pumped dry, a condition that many others had gone through. Resigning the position was decided upon by this short-time chief editor to escape a threatened attack of nervous prostration.

Selecting a variety of subjects for discussion every week is a most strenuous task that is only a little harder than the duty of selecting subjects for investigation and discussion by technical societies and clubs. Those who read the annual reports and monthly accounts of proceedings, have no idea of the difficulties overcome by secretaries and other officials in finding subjects that will present something new and valuable to the people interested in the work of technical organizations. We are not acquainted with any engineering literature of greater value to practical railroad men than the Proceedings of the Master Car Builders' and the Master Mechanics' Associations, yet the investigations and discussions are always full of new facts clothed in new thoughts that display no tendency towards threadbare conditions.

During the forty-one years of its existence the Master Car Builders' Association has been engaged on work that had intimate connection with the management of freight traffic, since the capacity of cars settled upon by the Master Car Builders' Association influenced strongly the charges made by the freight carriers. With that line of progress always calling upon car builders to increase the carrying capacity of cars, there was no want of subjects to occupy the attention of the annual convention committees and no one can truthfully say that the work done was unsatisfactory. When the whole work of making details harmonize with the change in the capacity of cars is considered, the wonder grows at the efficiency displayed with so little sign of pretention. To enumerate the details of car improvement worked out by the Master Car Builders' Association would be to publish a mass or reading matter beyond the limits of our available space.

To-day, the Master Car Builders' Association has no less than seven standing committees, most of them engaged on semi-expert work that is of the highest importance to railroad companies. The work done by the Arbitration Committee alone is worth more than all the time and expense incurred in keeping the Master Car Builders' Association in existence. Besides that, there are fourteen subjects under the investigation of committees, and besides all that the yearly investigations and discussions on the interchange of cars. How the useful labors outlined are to be finished in three days is beyond our comprehension.

When the American Railway Master Mechanics' Association was organized in 1868, the most common form of locomotion was of the eight-wheel American type with cylinders about 16x24 inches, driving wheels 60 inches diameter and a boiler providing about 800 square feet of heating surface, the grate area being usually about 16 square feet. The engine in working order weighed about 50,000 pounds. The railway world had passed beyond the experimental period of patent smoke preventing devices and bituminous coal was burned in plain fire boxes without much public criticism or opposition. Many railroad officials had come to consider that the locomotive was perfect for all practical purposes. Iron was king of this machine, boiler, firebox, tires, frames and driving wheels being of that material. The American Railway Master Mechanics' Association labored under a curious disadvantage for a few years, many of the higher officials having regarded it as an aristocratic form of labor union. The underpaid condition of the railroad mechanical officials naturally suggested the labor union suspicion. At several of the early conventions, prominent members considered it proper that they should deny that the association had any trades union tendencies. The published proceedings contained the best proof that the purpose of the organization was the collecting of information concerning railroad motive power that would improve the performance of the engine and increase its durability.

Notwithstanding the prevalent belief that the locomotive had nearly reached the summit of perfection, at the first convention committees were appointed to investigate eleven subjects and prepare reports of their findings. That was a strenuous beginning, for the convention lasted only two days, and there was much difficulty in getting all the business on the program transacted. In fact, the prevailing practice of cutting off discussions began at the second convention and has been continued ever since. The secretaries, presidents and executive committees, that have from time to time performed the duty of arranging the business of conventions, have never been embarrassed by scarcity of subjects of investigation. On the contrary, the cutting out of subjects to keep the business within bounds has frequently given offence to promoters of certain investigations.

The Fortieth Annual Convention, which opens at Atlantic City on June 22, will present twelve reports of committees and two individual papers to occupy the attention of members. All the subjects are well worthy of renewed investigation. None of them has the mark of a gap-filler, so the association will hold up the well-earned reputation of having plenty of subjects for investigation and a full measure of able members to conduct the work.

Locomotive Fireboxes.

The members of the Institution of Mechanical Engineers of London, England, have been discussing at considerable length the combustion processes is locomotives. Exhaustive experiments have been

made both with British and American types of locomotive fireboxes and the general conclusions reached verify the results of previous investigations. The fact that the most efficient boiler has the smallest box surface both absolutely and with respect to the fire grate has been repeatedly demonstrated. In the recent tests on the London and North Western Railway a locomotive with a British type of firebox with a surface of 161½ sq. ft. was kept for a period of five months on the heaviest and fastest passenger train running from London to Crewe. The distance covered was 34,348 miles, with a coal consumption of 882 tons, equal to a consumption of 57½ lbs. per mile. In the same period the locomotive equipped with the American type of firebox ran 34,013 miles, consuming 793 tons of coal, the equivalent average consumption being 52¼ lbs. per mile. The saving of coal in the latter case was about 10 per cent. The locomotives were alike in every detail excepting the type of firebox. The men selected for the work were the most experienced on the road and they exchanged engines from time to time, so that the conditions may be said to have been identical. An average speed of 57 miles per hour was made during the period.

A few general deductions are of value as showing the results of these interesting tests. The ratios of heating surface giving the best results are as follows: Grate to total heating surface, the grate surface being reckoned as 1, the total heating surface should be between 55 and 65. The ratio of the grate surface to the firebox heating surface as 1 to 5 to 5.5, and the firebox heating surface to the total heating surface as 1 is to 11 to 12. The range of temperature in the firebox varied from 1,856 degrees to 2,339 degrees. This temperature is lower than the average temperature in experiments with anthracite coal in America which approaches 3,000 degrees.

A novel point in the discussion was the statement by a speaker that locomotives were not run in the right direction. They should have the smoke stack, he claimed, in the rear. In a large locomotive running at a high speed, half a ton of air per minute was put through the firebox. Dealing with a speed of 60 miles an hour, the air had to be reversed, and then driven at that speed, in addition to the speed necessary to pass through the boiler, whereas if the engine were run in a reverse direction, there would be no reversal of air necessary; the draught would be freer.

The speaker may not have been aware that this style of engine running has been tried on several railways in Europe. The results were not encouraging. A free current of air is not always favorable to combustion. It can be readily demonstrated that it is in the careful admission of a limited supply of air that the most complete combustion takes place. A closed ash pan, with adjustable side openings, will be found to be more efficient than front or back openings. It is in utilizing the vacuum produced by the successive exhausts of a high pressure engine that the best results in maintaining a high temperature in locomotive fireboxes have been obtained, and it was the use of this feature that gave the locomotives of Trevethick and others their early supremacy over the locomotives using fan blasts and other devices.

B. of L. E. Convention.

The Eighth Biennial Convention of the Brotherhood of Locomotive Engineers was held at Columbus, O., last month, beginning on the 13th and extending over the remainder of the month. The arrangements for the convention were carried out by Mr. John H. Baker, one of the grand officers of the Brotherhood, and by Mr. Sam D. Hutchins, who was chairman of the Committee of Arrangements. The work must have been admirably managed, for the comfort of the members and guests was never more satisfactory. A most attractive opening program was arranged, about four thousand persons having assembled to honor the delegates and the organization they represented.

About 400 delegates attended the convention and many friends of the Brotherhood were there unofficially. The real business of the convention was begun by Grand Chief W. S. Stone, whose annual report indicated the policy their head wished the Brotherhood of Locomotive Engineers to pursue. The Grand Chief took a decided stand in favor of temperance. The rules at present declare that any member discharged from any position for drinking shall also be expelled from the order. It is recommended that this rule be so amended that any member who drinks either on or off duty shall be liable to expulsion. Another recommendation was that the convention carefully consider the question of interurban trolley men; also trolley men who work on cars which make up a passenger train service of railways.

It was recommended that the divisions ascertain the wish of members as to a pension plan, as the one adopted at Memphis is impracticable; that a committee be appointed to revise the constitution and by-laws; that an age limit of fifty years be established, so that no man may be taken into the order after that age if he has never been a member.

The Brotherhood of Locomotive Engineers is the most successful organization in the world for mutual benefit protection. Many other protective societies have been formed on the general plan of the Brotherhood of Locomotive Engineers, but no other has achieved so [illegible] success.

Half a century ago railroad officials were, as a rule, very arbitrary animals. Most of them had risen from humble positions and were filled with the pride of egotism, those who had failed to attain a similar altitude being regarded as weaklings whose rights were limited by the good-will of the head of the department. The infliction of cruel injustice became of everyday occurrence. Aggravated by maltreatment, various departments of railroad employees combined for mutual protection, but until the Brotherhood of Locomotive Engineers was formed all were short lived.

In April, 1863, a few engineers in the employ of the Michigan Central Railroad met at Marshall, Mich., and arranged for a large meeting, which was held in Detroit the following month. At that meeting the Brotherhood of the Footboard was organized. The forming of subdivisions was carried on vigorously and when a convention was held at Indianapolis in the same year, forty-four divisions had been formed. At that convention the organization name was changed to the Brotherhood of Locomotive Engineers. The Brotherhood grew and prospered, the members holding to the motto "Sobriety, Truth, Justice and Morality," which comprised much more than the motto of the first French republic—Equality and Fraternity.

There are now 744 divisions, representing over 60,000, of the Brotherhood of Locomotive Engineers. An insurance was established in 1867 and over 53,000 members belong to that medium of self-help. Like everything else connected with the order, the Insurance Department has been remarkably well managed. The death policy of $1,500 has cost only from $23 to $25 annually. A life and weekly indemnity department was established at last convention and is proving popular.

In 1887 a Ladies' Auxiliary of the Brotherhood of Locomotive Engineers was organized and has now about 20,000 members. At the Columbus Convention the Ladies' Auxiliary, through Mrs. Sproule, of Toronto, Ont., presented a fine silk British flag to the Brotherhood, on behalf of the Canadian delegates.

The present remarkably efficient officers of the Brotherhood of Locomotive Engineers are: W. S. Stone, G. C. E.; E. W. Hurley, A. G. C. E.; H. E. Wills, A. G. C. E.; M. W. Cadle, A. G. C. E.; F. A. Burgess, A. G. C. E.; W. B. Prenter, F. G. E.; C. H. Salmons, S. G. E.; R. W. Botterell, F. G. A. E.; J. C. Currie, S. G. A. E.; J. H. Baker, T. G. A. E.; F. H. Tucker, Grand Guide; G. R. Dority, Grand Chaplain. Insurance Department—W. E. Futch, president; M. H. Shay, secretary and treasurer.

Demanding Coke as Fuel.

It is amazing the number of people on the American continent who keep themselves in the public eye by posing under the guise of reformers or of playing the Don Quixote by attacking the windmills that swing their arms against public comfort. At present there is a decided crusade against smoke, pushed in all parts of the country because the agitators perceive in opaque smoke issuing from chimneys deadly poison liable to ruin the health of every individual who inhales a breath of soot-infected air. A person sitting for an hour in a smoking car will inhale more smoke than he would draw in even Pittsburgh atmosphere for a month; but that does not count in the eyes of the reformers; they are after the owners of furnaces, particularly those used in locomotives. When people are sufficiently persistent in shouting black death they will inspire their timid neighbors with dread that becomes an easy victim to agitation.

The remedy demanded at present is that railroad companies shall burn coke in their locomotive furnaces. There is something curious about the praise that coke as fuel is receiving at present and it might look as if the coke making interests are pushing the agitation in its favor, which we consider quite improbable. The advocates of coke fuel assert that it is free of smoke, gas, soot and dust, which is giving the material more than its due. It is free from smoke, nothing more, for its gas and dust are worse than the emanations of soft coal. Hard coal is a better fuel in every respect.

We have received several inquiries lately about how coke can be burned in a locomotive firebox so that the steam needed may be generated. The writer fired engines burning coke for several years and the same fireboxes were employed that afterwards were used for bituminous coal. The coke was broken to pieces as large as a man's fist and lay rather openly on the grates. On this account a deep fire had to be carried, otherwise the air would pass through the mass too freely. We think that engines with large grates would require the use of some dead plates to burn coke to the best advantage. Perhaps the nozzle might have to be contracted, but that could be demonstrated on a brief trial. To railroad companies preparing to adjust their locomotive fireboxes for coke burning under the stress of philanthropic agitation, we would say, make as few changes as possible. The clouds will roll by very soon and you will then be able to return to the comfortable smoke-making coal. That happy day will come all the sooner if the ordinary firemen are urged to do their work with bituminous coal in a manner that will reduce smoke to the minimum. It is not soft coal in itself that causes agitation in favor of coke; it is the careless firing of the soft coal.

Possibilities of High Speed Steel.

The numerous shop foremen among our readers and other mechanics interested in finishing machine work at the lowest cost would do well to read a paper recently presented to the Central Railroad Club by Mr. L. R. Pomeroy on Possibilities of High Speed Tool Steel. The paper gives an interesting outline of the history of high speed tool steel, then reviews in elaborate detail a most exhaustive series of tests conducted under the supervision of Dr. Nicholson, of Manchester, England, with the object of finding out the capabilities of high speed steels for ordinary shop operations.

A series of questions formed the basis of the investigation and were fully answered by the work done. Mr. Pomeroy's paper makes a full record of the answers, but unfortunately it is too long for our columns. The questions are:

(1) What maximum speeds can be obtained with the new steels when taking light or finishing cuts upon "hard," "medium" and "soft" cast iron?

(2) What maximum area of surface can be machined in a given time when taking a 3/16 in. cut with the new steels upon the six given materials?

(3) What is the greatest weight of cuttings which the new steels can remove in a given time from the three grades of steel and the three qualities of cast iron?

(4) What forces are operative in making these cuts, and according to what laws do these forces vary with the speed of cutting and the area and shape of the cut?

(5) Can the new steels be forged and tempered by an ordinary smith and yet be relied upon to give results as to cutting, speed and durability which will make their adoption decidedly remunerative to steel users?

When the startling revelations of what Taylor-White steel would do was first made public a strong tendency was displayed by shop foremen and others to make the best of it, but the enthusiasm gradually wore off and many people are now contented to use ordinary tool steel who would greatly profit their employers by giving high speed steel every opportunity to prove its cost saving value. We do not know of any better methods of persuading all concerned that it is their duty to adhere to high speed steel than a close study of Mr. Pomeroy's paper. We know of no better investment for railroad companies to make than to supply every shop foreman with a copy of this admirable paper. The possibilities of high speed tool test form not only an interesting subject, but a very important one.

The Value of the Steps.

A short time ago the daily papers were full of accounts of a famous French artist who had destroyed a number of his pictures which were valued at about $100,000 and which represented three years work. He did this, it was said, because he had come to the conclusion that they were unsatisfactory. He declared that none of his new works were worthy to pass to posterity.

No one denies his legal right to destroy his own pictures, but his action has raised the ethical question in a great many minds, as to an artist's right to destroy his own handiwork. He is an acknowledged master of the impressionist school, and the works destroyed were a series of studies of the appearance of water under various effects of atmosphere and light.

While we cannot here discuss matters which belong to the realm of art, it seems to us that the abstract question as to the quality of work which may have a distinctly educational value, and which may be helpful to others, should not be decided on personal grounds. It would have been more than unfortunate if many of the great engineers and discoverers had failed to give to mankind the fruits of their labors, imperfect or fragmentary though they were.

Heinrich Hertz, a German physicist, discovered the wave propagation of electromatic induction in 1888. Trouton found that these Hertzian vibrations were absorbed by glass. Prof, Branley used nickel-silver filings in a slender glass tube for the purpose of detecting the proximity of thunder showers. This instrument is called a coherer, as the filings cohere when acted upon by the Hertzian waves. Marconi put these discoveries together in practical form and gave us wireless telegraphy.

Faraday discovered the principle of electric induction but left the work of inventing the dynamo to others.

Darwin worked silently for forty years on the theory of natural selection, which was to revolutionize the thought of the whole world, and though the theory as he presented it had many "missing links," it was given to the world without one touch of personal vanity.

If any of these men had hidden the light of their wonderful discoveries or had deemed them too imperfect to be passed on to others, the progress of worldwide science would have been retarded.

No man lives entirely to himself, and no man's work is entirely his own. From the ethical standpoint, even though the conscientious endeavor of the skilled worker may not satisfy him-

self it is not his to destroy. The law of evolution under which we all live decrees that progress must be made by trial, by failure, and by slow advance. One individual cannot compass all. The work of one may supply just the needed impulse for the successful achievement of another. The old-time idea of trade secrets has given way to a broader view, and so-called mysteries have disappeared. In the ordinary life of a railroad man he may not have the opportunity nor even the equipment for making great discoveries, but he may safely apply this guiding principle in his daily occupation. That which he finds out by hard work or study, and what is worth knowing or doing rightly in his own case, must be useful to other workers in the same field, and the very steps he has taken to gain his knowledge or his proficiency will most likely be of some value to those around him or to those that follow after.

Lehigh Valley's Signal Tests.

After a series of what has been called surprise tests recently completed, officials of the Lehigh Valley Railroad find that the enginemen on every division have made a perfect record for obeying signals.

The essence of the so-called surprise test idea is that a record is kept. The man at the throttle has no way of knowing that the signal is not set by the train ahead; but, whatever the cause, his duty is to obey, and he does it for the sake of his own and the passenger's life. Some other railroads, in recent years, have adopted this record system as an incentive to good performance, and the results have been satisfactory.

On the Lehigh Valley the entire main line is now equipped with automatic block signals. The frequency of the signals is dependent upon the density of traffic. The signals are in normal position when they are at danger. That is, they rest at danger and have to be changed to indicate a clear track. If, for any reason, the mechanism is out of order, or if the electric circuit is broken, signals are left so as to stop the first train.

During every test a strict record is made. First comes the number of the signal, then the number of the train, the number of the locomotive, the name of the engineman, the direction of the train, the exact time of reaching the signal, the position of the signal, the action of the engineman. These facts tell the whole story. They are put into tabulated form and kept as a permanent record. Three officials, at least, conduct each test, so that there is no chance of their incorrectly recording an engineman's action. The officials' names are signed to the report. The tests necessarily produce a high state of efficiency in signal maintenance, which is a satisfaction to all concerned. There is really no "surprise" about this checking system. The only thing is that the men are not informed which signal will be used for test. They are required to obey the signal without reference to why it gives a certain indication, and they do it.

The tests just made include 107 separate cases. Some of the tests were made in the forenoon, others in the afternoon, other in the night and early morning hours. The signals were set mostly at danger. Sometimes, at night, the lights were extinguished. In all these cases the response of the enginemen showed that good work of a highly conscientious order was being done by them, and the officers of the road have every reason to be proud of the record made.

At one place on their lines the Lehigh Valley have installed the staff system. The six-mile stretch of track between Silver Brook Jct. and Laurel Jct., on the Mahanoy and Hazleton Division, is equipped with it. This piece of road is between stretches of double track, so that it accommodates trains going in opposite directions. The character of the country here practically prohibits double-tracking.

Injectors.

The so-called mysterious action of the injector in forcing water into the boiler against the same pressure of steam that induces motion in the water cannot be accounted for on any other hypothesis than that the water being a comparatively heavy body and steam a comparatively light body moving at high velocity the water has the effect of condensing the steam and of producing a stream of warm water moving slower than the steam it is true, but heavy enough and fast enough to unseat the check valve against the pressure of the steam. If the water in the delivery pipe was not in motion it would not be able to enter the boiler.

The combination of water and steam forms a jet which has force enough to open the check valve and enter the boiler. It will be observed that cold water will flow more readily than heated water, but as the latter is more economical injectors can be so constructed so as to use water having a considerable degree of heat. There are two important requisites in the proper working of all kinds of injectors. The first essential point is that all the joints leading to or from the injector should be perfectly tight. The slightest leak affects the operation of the instrument. The other feature, no less important, is that the injector be kept perfectly clear of internal obstructions. In [illegible] water and steam and preventing the [illegible] of scale from impeding access to the injector; this latter trouble is the chief cause of very many injector troubles. The tapering passages in the chambers of the injectors are such that hard scale deposits often find lodgement there. It will also be found that after an injector has been in service for some time it will become coated with the same substance as adheres to the inner shell of the boiler and flues. It is good practice to immerse the injectors occasionally in a solution of muriatic acid and water, the mixture being about ten or twelve parts of water to one of acid.

The relative size of the nozzles and the correct taper of the tubes are very important and their alignment must be correct. Any derangement of these injuriously affects the working of the injector. In fact, it is an instrument of precision as much as a Winchester rifle or a Colt's revolver, and its accuracy of operation depends very largely on the way it is treated.

In the principal locomotive repair shops a supply of injectors cleaned, repaired and tested are usually kept on hand, so that when an injector is reported to be defective it can be disconnected and another put in its place, thus avoiding delay and allowing the skilled mechanics to examine them under favorable conditions and with proper tools at hand. The practice of striking injectors with hammers or other hard tools is very objectionable. The blows very seldom have the effect of clearing any obstruction lodged in the chambers or tubes of the injectors, while the appearance of the injector is irretrievably destroyed.

Train Resistances.

At a recent meeting of the Institution of Civil Engineers held in London a paper on the Influences Affecting Train resistances was read by Mr. C. C. Wilson, in which, among other things, he said that regarding roller bearings in railroad service the real value of this form of journal bearing lay in the reduction of running resistance and not in the reduction of the starting effort. Some tests of roller bearing on the Eastern Bengal State Railway showed a saving of one per cent. in the energy required to keep the cars in motion, above that obtained by calculation, using the resistance formulas.

The resistance of the coach was shown to depend very largely on the wheel base of the truck and the relation of the truck weight to that of the whole coach. The influence of the truck on train resistance was stated to be greater for goods wagons or freight cars, as we would say, than it was for passenger coaches. The greater resistance per ton of an empty car over that of the same car when loaded was explained by the relation existing between

the truck weight and the weight of a whole car. The amount of play between flange and rail is also an important factor in train resistance. The speaker referred to the want of uniformity in this particular on railroads in Great Britain, the United States and on the Continent. The increased resistance and wear occasioned by large flange play, he believed, indicated the advantage to be gained by its reduction to a standard of 3/8 in. as adopted by the London and South Western Railway.

Referring to the relative importance of air resistance Mr. Wilson referred to the work of the St. Louis Electric Railway Test Commission, by which it was shown that a large reduction in front and rear air resistance can be effected by suitably shaping the ends of the trains. On motor-driven coaches the extra weight of the motor trucks increases the flange friction of such coaches and it was stated that the resistance of electric motor coaches was found in some cases to be as much as 54 per cent. greater than that of trailer coaches running at the same speed under similar conditions.

Efficiency of Heating Surface.

There have lately been some experimenters in Great Britain who, in dealing with the condensation of steam in the cylinders of engines, have advanced the theory that the steam is in the cylinder too short a time to account for all the heat losses that take place, and that slide valve leakage is probably the greatest factor in producing the effects noticed.

There is no doubt that some slide valve leakage takes place in nearly all engines, but the transference of heat from steam to cylinder-wall is very rapid, nevertheless. As an example of heat transference, the waste gases of combustion pass very rapidly through the tubes of a boiler, and yet in the short time they are flowing over more or less soot-covered surfaces they manage to give up a very great deal of heat, and reasoning by analogy it is quite fair to believe that steam in a cylinder can part with its heat with great rapidity.

In water tube boilers the first few tubes which the hot gases encounter take up probably as much heat as all the rest put together and this raises the question of what is effective heating surface in a boiler? There is, as it were, such a thing as quality or effectiveness in heating surface, and that is one of the things sought for in the design of the Brotan boiler. The example we gave last month shows that the heating surface of the tubes in the firebox and of the parts of the firebox exposed to the fire when taken together equals the heating surface of the horizontal tubes in the boiler. One of the claims for this design is the increased efficiency of the heating surface provided.

Inspecting Boilers in France.

The effect of the laws regulating the inspection of steam boilers in France, which were supposed to be somewhat drastic in their nature when adopted by the National Government, are showing the most gratifying results in the important item of freedom from fatalities. Ten years ago the number of fatal accidents from boiler explosions approached a ratio of four in each ten thousand during a five-year period. The rate has now fallen to less than two in the same number and period. The recent regulations adopted by the Public Utilities Commission in New York State approach nearer to the French laws, perhaps, than that of any other State, but it would be well if the whole subject was taken up by a National Commission the recommendations of which would likely meet with the approval of the State Legislatures.

As statistics show, the most frequent cause of fatal accidents from boilers is bad maintenance. The French system imposes the keeping of a regular log, like that on board a vessel, recording all the tests, inspections, cleanings and repairs, all of which are obligatory on the owner, at regular intervals. The regulations do not apply to the very low pressure boilers used for warming buildings.

Book Notices

Autogenous Welding of Metals. Translated from Reports of the National School of Arts and Trades of France, by L. L. Bernier, M. E. Published by The Boiler Maker, New York. 46 pages. Illuminated paper. Price, $1.00.

This work gives a brief and clear description of the application of Autogenous Welding to the manufacture of tanks, gasometers, receptacles for liquids or gases, steam and hot water boilers, automobiles, piping, either steel, copper or brass; and coils of all kinds. It also gives directions for its application to repairing old or new castings that may be injured through blow-holes or cracks, and in the general manufacture of steel, brass, bars and plates, and other work. The description of the work performed is in many instances particularly interesting and we heartily commend the work to all who are interested in Autogenous Welding.

Betterment Briefs. A collection of Published Papers on Organized Industrial Efficiency, by H. W. Jacobs. Printed by Crane & Co., Topeka, Kan. 240 pages. Profusely illustrated.

Mr. Jacobs has been long and favorably known as a writer of marked ability, and the superb volume before us is a collection in chronological sequence of some of the author's papers on the new movement for the scientific betterment of American railroading. Many of these papers have appeared in the press. The value of these papers is greatly enhanced by the classified arrangement in which they appear in the present volume. Mr. Jacobs is particularly interesting on the important subject of standardization of the small-tool equipment, and it would be well if his able work had a large circulation among those who are engaged in the organization and efficiency of the railway machine shop.

Locomotive Experiments. Book I. Locomotive Indicating. The Locomotive Publishing Co., London, England, and Angus Sinclair Co., New York. 72 pages. Flexible cloth.

This is the first of a series of hand books on locomotive experiments which are the results of a series of tests conducted under a variety of circumstances and upon every kind of locomotive in use. As is well known, the practical carrying out of a locomotive test under actual working conditions on the road is beset with difficulties of various kinds. Many of these obstacles are obviated by the use of shop testing plants, but such advantages are gained at the sacrifice of actual working conditions. The first volume of this series deals with the various phases of locomotive indicating and will be found of real practical value to the practical railway man.

The twenty-first annual report of the Interstate Commerce Commission issued by the Government Printing Office is at hand and is of interest to railway men in view of the fact that it contains a number of decisions of the United States Supreme Court in cases affecting rate schedules and application of rates. An interesting chapter is devoted to Block Signals and automatic train stops. The book has much of the fullness and consequent dullness of Government reports. Pages 287 and 288 are heroically eloquent in describing the incidents on which the awarding of life-saving medals were made during the period covered by the report.

The *Railway Magazine*, of London, is publishing extracts from the diary of David Joy, the celebrated locomotive superintendent, edited by Mr. G. A. Sekon. The historical matter is highly valuable and the publication preserves numerous facts about pioneer railway times that would otherwise be lost. The notes made by David Joy embrace the most valuable period connected with the early development of the locomotive and is for British practice what a diary kept by Isaac Dripps or James Milholland would have been to Americans.

Applied Science Department

Elements of Physical Science.

XIV. CHROMATICS.

That branch of optics which treats of colors is called chromatics. All white light is composed of seven primary colors combined in different proportions. The rainbow is the most clearly defined natural phenomena illustrating the existence of the primary colors in sunlight and taking the form of an arch. It will be readily noted that it appears in the opposite quarter to the sun. It occurs only when the air is filled with drops of water and the sun shines through them at a certain angle. It is caused by the refraction and reflection of the sun's says. Sometimes two bows are seen, one within the other. The eye of the observer is so placed as to receive but one of the colors from one drop, but from other drops the eye receives other colors and so on, the whole receiving an arched combination of the seven colors.

The solar spectrum affords a beautiful illustration of the primary colors and can be readily shown by admitting the sunlight into a dark room through a small opening. Without interruption the ray of sunlight will form a spot of white light in the darkened surface receiving it. If the ray of light be received on a glass prism at a little distance from the opening, the white spot on the wall will immediately move upwards on the wall and form an oblong space composed of seven colors, consisting of violet, indigo, blue, green, yellow, orange and red. These colors are always shown in the same position, red occupying the lower place and violet the highest. They do not occupy equal portions of the spectrum.

Violet occupies more than one-fifth of the entire space, orange occupies one-thirteenth. According to the undulatory theory propounded by Thomas Young and elaborated by others, color depends on the size of the minute waves that produce it. The undulations from a red object are the largest and are calculated at one-thirty-eighth thousandth of an inch in breadth. The undulations that produce violet are calculated at one-sixty-thousandth in breadth. The other colors are produced by undulations varying between these limits.

Colors may be said to have an affinity for each other and each particular color appears to the best advantage when placed beside its complementary color, thus orange and blue, and green and red, yellow and violet are seen to advantage when placed together. It is a curious fact that in this arrangement of colors there is a natural selection that spontaneously occurs to the eye, as when looking intently at a red object a circle of light of green seems to gather around it, and so on with the other colors.

Every ray of light possesses three distinct properties—brightness, heat and the power of producing chemical effect. This last quality is called Actinism and is strongest in violet and indigo rays. Seeds placed under dark blue glass will germinate much more rapidly than under ordinary light. Under red glass seeds will germinate very slowly, if at all. The colors also vary in degrees of heat. The bulb of the thermometer placed in each of the colors of a fixed spectrum will show surprising variations, red being the highest. Light from burning metals contain colors similar to those found in the sun and stars. Hence it is inferred that the atmospheres of the sun and stars contain the vapors of the metals in question, and that these metals are in a state of incandescence, a white heat on the surface of these heavenly bodies.

SCENE ALONG THE SOUTHERN RAILROAD.

VISION OF COLORS.

Color blindness has been the subject of much learned dispute. It is now generally agreed that the normal eye has only three color sensations—red, green and violet—and that the apparent color of any light which falls on it depends merely on the relative intensities of the excitement produced by the light on the three organs of sense corresponding to these sensations. Extremely bright light, whatever be its color, seems to excite all the three sensations simultaneously, much as white light does, and again in very feeble light we are almost unconscious of color. In color blindness one or more of these organs of sense is wanting or imperfect. John Dalton, the celebrated physicist and founder of the atomic theory of chemistry, gave the first account of that ocular peculiarity known as false vision of colors, sometimes called Daltonism. His own experience is particularly interesting. Being present at a review of troops, and hearing those around him expatiating on the gorgeous effect of the military costume, he asked in what the color of a soldier's coat differed from that of the grass on which he trod; and it was the derisive laughter and the exclamations of his companions which this question called forth that first made him aware of the defectiveness of his eyesight. Besides the blue and purple of the spectrum he was able to recognize but one color, yellow. The part of the image called red appeared to him little more than a shade or defect of light. Other colors seemed to him to descend from an intense to a rare yellow, so that with the exceptions of blue and purple his vision could

only comprehend varying shades of yellow.

THE HOLMGREN TEST.

An important feature in testing candidates for employment in many departments on railways is what is known as the Holmgren test. This consists of placing a number of colored worsteds on a table in good, clear daylight. A test skein is selected and placed at a distance of about two feet from the others and the candidate is asked to select from the heap of colors all that look to him like the test skein. An exact match is not expected, but all that are of the same general color, lighter or darker. This selection is frequently repeated more than once. A candidate defective in color perception may pick out some greens as well as some gray or brown colors that may appear to him of the same general color as the test skein. Prompt or hesitating selections are noted. No names of colors are mentioned in the tests, a comparison of colors being the real test.

If a candidate selects any of the red shades as looking like green it is a sure sign of defect in color vision, so also does a selection of gray or brown as looking like green. If, on the other hand, green should be selected as looking like red, the candidate would likely be rejected. The naming of colors or shades of colors is no part of the test, as it is only those who are familiar by long experience with the endless varieties of the mixtures of colors who can name them correctly. Red and green as commonly used in railway signals are a sufficient test as to the color blindness of a candidate, and it may be noted that this peculiar defect is exceedingly rare.

Soldering.

The term soldering is generally applied when fusible alloys of lead and tin are employed for uniting metals. When hard metals which melt only above a red heat, such as copper, brass or silver, are used, the term brazing is sometimes used. Hard-soldering is the art of soldering or uniting two metals or two pieces of the same metal together by means of a solder that is almost as hard and infusible as the metals to be united. In some cases the metals to be united are heated, and their surface united without solder by fluxing the surfaces of the metals. This process is then termed burning together. Some of the hard soldering processes are often termed brazing. Both brazing and hard-soldering is usually done in the open fire on the brazier's hearth. A soldered joint is more perfect and more tenacious as the point of the fusion of the solder rises. Thus tin, which greatly increases the fusibility of its alloys, should not be used for solders, except when a very easy-running solder is wanted. Solders made with tin are not so malleable and tenacious as those prepared without it. The Egyptians soldered with lead as long ago as B. C. 1490, the time of Moses. Pliny refers to the art, and says it requires the addition of tin to use as a solder. The tin came mainly from the Cassiterides (Cornwall). Plumbers use solder composed of two parts of lead and one of tin, and a very slight variation in the quantities makes a very considerable difference in the working and also in the soundness of the joint. If a slight excess over the above proportion of lead is used, the solder is more difficult to work, and the joint when made frequently leaks, the water passing through the small cellules or pores in the metal, and the joint is then said to "sweat." If an excess of tin is used, the solder melts too easily, and considerable difficulty is found in keeping it on the joint, and it cools so suddenly that the joints always look rough and ragged at the ends. They sometimes require trimming up to make them look better; this solder also keeps running, and then congealing, in such a way as to be difficult to keep it at a workable heat. Small portions of the metal also keep sticking to the cloth used for molding (technically called wiping) the joint or seam as the case may be.

Plumbers' solder, with the above proportions, on being melted, and then allowed to cool, will generally exhibit several bright spots on its surface, due to the two metals partly separating. These bright spots are generally a very sure guide as to the proper quantities of each metal used. If none are seen, it is too coarse; and if too many are seen, it contains too much tin and is said to be too fine. If the spots are small the metal may not be good, although it may have beyond its proper quantity of tin; but if the spots are about the size of a threepenny piece the solder very rarely fails to work well. In uniting tin, copper, brass, etc., with any of the soft solders a copper soldering-bit is generally used. This tool and the manner of using it are well known. In many cases the work may be done more neatly without the soldering-bit by filing or turning the joints so that they fit closely, moistening them with the soldering fluid described hereafter, placing a piece of smooth tin foil between them, tying them together with binding wire, and heating the whole in a lamp or fire till the tin foil melts. Pieces of brass are often joined in this way so that the joints are invisible. With good soft solder almost any work may be done over a spirit lamp, or even a candle, without the use of a soldering-bit. Advantage may be taken of the varying degrees of fusibility of solders to make several joints in the same piece of work. Thus, if the first joint has been made with the fine tinners' solder, there would be no danger of melting it in making a joint near it with bismuth solder. The fusibility of soft solder is increased by adding bismuth to the composition. An alloy of lead 4 parts, tin 4 parts, and bismuth 1 part, is easily melted; but this alloy may itself be soldered with an alloy of lead 2 parts, bismuth 2 parts, and tin 1 part. By adding mercury a still more fusible solder can be made. Equal parts of lead, bismuth and mercury, with two parts of tin, will make a composition which melts at 122 degrees Fahr.; or an alloy of tin 5 parts, lead 3 parts, and bismuth 3 parts, will melt in boiling water. In melting these solders melt the least fusible metal first in an iron ladle, then add the others in accordance with their infusibility. It is convenient—and, in fact, often necessary—to have solders which will melt at different degrees of temperature to avoid the risk of spoiling the work by subjecting it to too great a heat, when, with a little easy flowing solder, there would be no danger.

Questions Answered

ANGULARITY OF THE CONNECTING ROD.

(42) W. E. V., Harrisburg, Pa., writes: Regarding Question No. 37 in your May issue, I do not see why the piston will have a longer distance to travel in going from centre of cylinder to front end and returning to centre, providing there is no lost motion. Suppose engine to have 24 ins. stroke, and pin is on top quarter, the crosshead will move 12 ins. forward and return 12 ins. and engine will then be on bottom quarter. Why should not the same distance be covered in going from bottom quarter to back end and up to top quarter? With a stationary engine I believe this would hold true in starting, but I do not see the point with a locomotive. —A. The locomotive and the stationary engine are alike in this matter. When the crank-pin is exactly on the top or bottom quarter, the piston is not exactly in the centre of the cylinder; it is slightly nearer the back end. Suppose you put the piston exactly in the centre of the cylinder, the distance from the wrist pin to the centre of the main driving axle is the length of the connecting rod. Now with that length fixed, drop the crank-pin end of the connecting rod from the centre of the main driving axle down to the crank-pin on the bottom quarter and look what happens to wrist-pin, crosshead and piston. They all move slightly toward the back end of the guides, because the connecting rod is now at an

angle with the guides and not parallel to them, and the connecting rod length is fixed. The same is true with crank-pin on the top quarter. This little deviation of the piston from the exact centre of the cylinder is due to the angularity of the connecting rod. With this fact in your mind read over the answer to Question No. 37 again.

(43) J. W. C., Campbell, Mo., writes: When an engine is pulling a train of cars on a level track or up-grade, is the strain greater on the couplings near the engine or upon those near the rear end of the train? If the strain is greater upon the front couplings, how much greater is it?—A. The strain is greater on the couplings at the front of the train, but it is not possible to say how much greater when no weight of train or other data is given. Attempts have been made to use what was called a continuous draw-bar attachment. This was a system of through rods connecting the draw-bars at each end of a car. When a train thus equipped was coupled up the draw-bars and rods throughout the train formed, as it were, one long continuous chain, and the frames of the cars were relieved of strain. It was like drawing a chain along the ground and hooking a weight into every link. A weight so hooked in did not get the strain from those behind it, but the chain itself had more strain put upon it the more weights were hooked in. As it usually is now, the car frame is strained in the act of pulling and the more cars on the train the heavier the strain on the couplers at the front end. In making a dynamometer test, the dynamometer car is always put behind the tender, so as to record the maximum pull.

LENGTH OF ECCENTRIC BLADE.

(44) J. G., Paris, Tenn., writes: Getting the correct length of an eccentric blade before the wheels are put under engine or, for instance, the blade was badly bent and broken and you wanted to get length with wheels under engine and you did not want to use any of the other blades to get length from. I understand you cannot get the exact length, but to get it within 1/8 or 3/16 of an inch.—A. In all classes of locomotives the distance between the center of the axle to which the eccentrics are attached and the center of the rocker is readily found either on the drawings usually kept in the shop or by measurement, the frames being almost always marked across the respective centers on the top of the frame. Unless the rocker is offset in the arms, the distance between the centers referred to is the same as that between the centers of the eccentrics and the centers of the links. The length of the eccentric blade depends on the amount of space occupied by the eccentric casting taking the distance from the center of the casting to the point of nearest contact with the blade. Allowance must also be made for the distance between the center of the link and the center of the hole for the eccentric rod pin.

STEAM ENGINE INDICATOR.

(45) Apprentice, Fort Wayne, Ind., writes:

I am a reader of several mechanical papers and I frequently see mention made of things shown by the steam engine indicator. I should like to understand the working of that instrument, but not having a college education I suppose the information is beyond my reach. Can you give me any help? A. It does not require a college education to understand the steam engine indicator and to operate it. There is a chapter in Sinclair's 'Locomotive Engine Running' on Steam and Motive Power that gives plain instruction about the indicator. An excellent book on the subject is Indicator Practice and Steam Engine Economy, by F. F. Hemenway. Besides giving plain instructions on the indicator, that book is one of the best treatises on steam engineering that we are acquainted with. It costs only two dollars when purchased through our Book Department.

POSITION OF LINK BLOCK.

(46) G. W. C., Mt. Carmel, Ill., writes: I notice that there is a difference in the Walschaerts movement on some of our engines. The decapod switch engine when in the forward motion has the link-block in the top of the link and in the backward motion the block is in the bottom of the link. On all our other Walschaerts gear engines when in the forward motion the link-blocks are in the bottom of the links. Would you kindly say what the difference is and why? The decapod engine I have reference to was built by the Brooks Locomotive Works and is a 24 x 28 in. cylinder, piston valve and is an inside admission engine. I have studied it out every way and I cannot see why it is.—A. In this case it was for the sake of simplicity of design. The American Locomotive Company inform us that the reverse shaft bearing and link bracket in this Brooks engine are both bolted to the guide yoke. With this location of the reverse shaft the radius rod is necessarily connected to a backward extending arm of the reverse shaft and the reach rod to an upward extending arm, the result being that when the reverse lever is in forward position the link-block is at the top of the link. The only difference this arrangement of reversing mechanism makes in the rest of the gear is that the eccentric crank leads the main pin when the engine is running forward; whereas, with the usual arrangement of the Walschaerts valve motion for inside admission valves, where the link-block is at the bottom of the link when motion is in forward gear, the eccentric crank follows the pin.

Celebrated Engineers.

VIII—William Murdoch.

Great inventors, like great commanders of armies, are generally fortunate in attracting kindred spirits around them. These lieutenants rarely receive full credit for their work. Sometimes their merits are purposely obscured by the leading spirit, who prefers to shine alone. Sometimes they prefer obscurity. William Murdoch is a fine illustration of a clever inventor and skilled mechanic who was willing to conceal his own marked individuality in the overshadowing splendor of a greater kindred spirit. He was a native of Ayrshire, Scotland, where he was born in 1754. His father was a millwright, and young Murdoch followed the same trade, and at the age of twenty-two he found employment in the machine shops where Watt's engines were being constructed. He became mechanical superintendent of the works and remained in that capacity over fifty years. James Watt owed much to William Murdoch. The ideas of the master inventor found ready realization in the skilled hands of the clever mechanic. He even went beyond the dreams of Watt, whose chief work was the perfecting of the stationary, condensing, steam engine. Murdoch went a step further and produced a locomotive that ran about the works, but, strange as it may seem, Watt did not encourage the perfecting of the locomotive, or steam carriage, as it was called. It is difficult to understand on what kind of reasoning Watt's conclusions were based. He was modest and unselfish and very strongly attached to Murdoch. Possibly the harassing lawsuits, in which he was constantly involved in his honest effort to protect his inventions in connection with the stationary engine, prevented the contemplation of adapting his great machine to locomotion or marine service.

Murdoch quietly kept on with his work. He produced the first engine equipped with oscillating cylinders, and also the first rotary engine, both of which subsequently came into considerable favor. It is also claimed that he invented the D sliding valve, and it is much to the credit of both Watt and Murdoch that they always worked harmoniously together, neither showing any anxiety about the claims of originality of thought or method. It seemed that when Watt suggested something new, Murdoch produced it, and thus these two master minds brought the new wonder of the world to a degree of perfection in their own day which has been but little improved upon in the succeeding century.

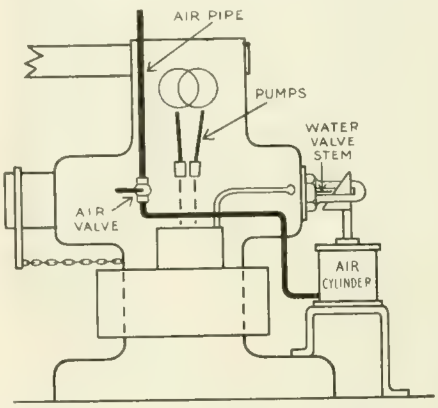
In the important department of machine shop tools necessary in the construction of the steam engines, Murdoch produced a variety of machines hitherto undreamed of in the mechanical world. Like the steam engine itself, they were all of massive design and of the very best workmanship. Weight in material seemed to be a strong feature of Murdoch's as well as of Watt's work. This degree of ponderousness is the more surprising in view of the light pressure of steam at which the boilers were kept. In this regard Murdoch was far in advance of Watt, who apparently was reluctant in attempting the use of steam at a high pressure. It seemed that boiler construction did not keep pace with machine work and, although Murdoch practically produced the high pressure engine, he was not encouraged on this important feature by Watt to the degree which might naturally be expected.

During a period in which the use of the crank was kept in abeyance by some legal entanglement, Murdoch devised the beautiful arrangement in mechanism known as the "Sun-and-Planet" wheels, and kept the engine going in spite of the law's delay. He was great in emergencies. Stories are told of personal adventures that throw strong light on the character of the man. In Cornwall one of the engines had broken down and Murdoch was sent to repair it. It appears that a body of miners had become exasperated at the delay in resuming work and threatened personal violence to Murdoch. Their threats of assault were met by Murdoch with a battery of blows that produced a panic among the amazed miners. When the engine was set going again, Murdoch was carried shoulder high in triumph by his former assailants.

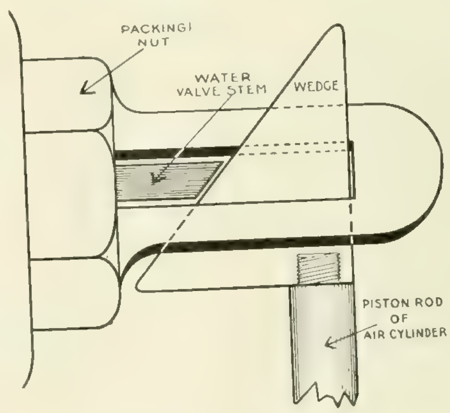
Apart from his constant and valuable improvements in mechanism, he began later on to experiment with inflammable gases, and about the end of the century he obtained a patent on gas for illuminating purposes. It is a remarkable fact that Watt and Boulton's works, where the first steam engines were constructed, were the first buildings to be completely lit up with gas. The gas producing machinery, which this new and important method of lighting called into existence, was largely the invention of Murdoch, and added greatly to the amount of construction work produced by the engineering firm.

Murdoch was also the first to use compressed air as a motive power in the driving of machinery. In the operation of hoists, and in the transmission of letters and packages, he made use of a tube from which the air was exhausted and demonstrated the possibility of the pneumatic tube as a swift means of commercial intercourse.

He lived to see the steam engine adapted to locomotion and with the exception of the rails upon which the engine moved, every other part of the mechanism had been already produced by him in miniature. He rejoiced in the success of others in the various fields where he had labored so long and so well. He was a lovable and delightful character. Great in mind and body, he was great in heart and soul. Envy never seemed to come near him. He found his life work in constructing and perfecting Watt's engine. The two great men were like Saul and Jonathan—beautiful in their lives, and it was peculiarly fitting that near the graves of Watt and Boulton the remains of William Murdoch, their wisest and best friend, were also laid. A fine marble bust, the work of Chantry, marks the spot and perpetuates the image and memory of the great and good man.



AIR VALVE APPLIED TO PRESS.



DETAILS OF AIR VALVE.

Air Valve for Wheel Press.

A very expeditious method of reducing the amount of time and labor in the operation of mounting car wheels has been got up by Mr. J. J. Acker, the car foreman of the Rock Island Lines, at Horton, Kan. The device has also the merit of increasing the accuracy with which the work may be done.

The idea is briefly the application of air to operate the valve of an hydraulic wheel press, and the air valve is placed in the position most convenient for the man in charge. In ordinary wheel presses the feed water going to the pump is controlled by a screw valve operated by a hand wheel, and where this valve is placed at the end of the machine it necessitates the operator walking close up to this valve in order to regulate it, or else to stand by it all the time while another man looks after and gauges the wheels.

The plan adopted by Mr. Acker is to substitute for the screw valve a plain compression valve which is held closed by the air pressure on a piston. The stem of this valve projects out through a specially designed packing nut which has a projection ½ in. thick standing out from it in the form of a loop about 3 ins. long. Up and down in this loop a wedge-shaped little crosshead is made to move by the operation of an upright air cylinder placed below it. This piece of mechanism is at the end of the wheel press, and the compressed air for the upright cylinder reaches it through a pipe so placed that the operating air valve is quite convenient for the man working at the press.

When air is admitted to the cylinder its piston rises, and the piston rod with the wedge-shaped crosshead goes up, the flat back of the wedge sliding along the outer end of the slot in the packing nut "loop." The wedge forces back the water valve stem and so closes the valve. When air is released from the upright cylinder its piston and rod descend and the wedge-crosshead comes down and the water pressure opens the water valve by means of the pressure of water in the press. The water valve can be opened or closed very quickly and any degree of opening may be secured according to the movement of the wedge-crosshead.

The operator is thus enabled to stand right up to his work and has the wheel right before him as it is pushed on or off the axle by the hydraulic press. At the final stage a minute movement of ram can be obtained by the sharp action of air valve.

This device, which is not patented, has had the effect of greatly increasing the output of the wheel press, as the little air cylinder works quickly in either direction. The device is an ingenious application of air in railroad shop practice, and it reduces labor and saves time.

How would it be when speaking of all matters connected with the flow of air into the ash pan, firebox flues and front end of a locomotive to use the word "draft," and when dealing with car material, couplers, pullings and buffing shocks to use the word "draw?" In this sense draft appliances would refer to things connected with the flow of air caused by the exhaust of a locomotive, and draw gear would refer to the pulling equipment of cars. This is just a suggestion, "You pays your money and you takes your choice," as the showman says.

Air Brake Department

Westinghouse Brake Equipments.

QUICK-ACTION AUTOMATIC BRAKE.

The modern steam railroad brake may be said to date from the appearance of the Quick-Action Automatic Brake in 1887, at which time it became apparent that a brake equipment must be provided capable of satisfactorily handling trains of 50 cars. The quick-action feature becomes operative when the brake pipe reduction takes place suddenly instead of gradually, as when a hose bursts, a conductor's valve is used or the brake valve handle is placed in emergency position. The first triple valve then operates in such a manner as to vent some of the air in the brake pipe to the brake cylinder, in addition to that flowing from the auxiliary reservoir to the cylinder, thus augmenting the cylinder pressure and causing a local reduction in brake pipe pressure which starts the next triple valve to "quick action," and so on serially throughout the train. The straight air and plain automatic systems, which preceded the quick-action automatic brake, soon disappeared from general service.

HIGH-SPEED BRAKE.

In 1894 the high-speed brake was perfected. The principles utilized by this equipment had been thoroughly and practically demonstrated by the Westinghouse-Galton tests in England in 1878. These tests showed that, while the adhesion between the wheel and the rail—which causes the wheels to persist in their rotation—is practically uniform at different speeds, the friction between the brake shoe and the wheel—which resists the rotation of the wheel, and thereby stops the train—is considerably less when the wheels are revolving rapidly than when they revolve slowly. It was thereby demonstrated that a greater pressure could not only be safely applied to the wheels by the brake shoes, at high speeds, but also that such considerably greater brake shoe pressure must be applied to the wheels at high speeds, in order to resist the motion of the train as effectively as it is resisted with the more moderate brake shoe pressure at low speeds. This was accomplished by the use of the standard quick-action brake apparatus with only the addition of a high speed reducing valve attached to the brake cylinders. Superior stopping capacity is obtained by increasing the brake pipe air pressure from 70 lbs., as used with the quick-action brake equipment, to 110 lbs. The operation of this equipment is similar to the quick-action automatic brake except that (1) when more than 60 lbs. is obtained in the brake cylinder during service applications the high speed reducing valve opens to discharge from the brake cylinder so much air as is necessary to restrict the cylinder pressure to 60 lbs.; (2) during emergency applications the blow-down to the atmosphere through the high speed reducing valve is slow at first, but gradually becomes more rapid, being so timed that the high brake cylinder pressure is held while the speed remains high, but is gradually reduced as the speed is diminished and the holding power of the brakes becomes more effective.

DOUBLE PRESSURE CONTROL—SCHEDULE U.

For freight service, particularly in heavy grade work, the possibility of utilizing a brake pipe pressure higher than 70 lbs. is a considerable advantage. The development of the high-speed brake equipment suggested a very simple ar-arrangement by which this desirable result might be obtained. This was accomplished by attaching the 70 lb. feed valve to a reversing cock, instead of to the brake valve as before, and attaching to the other connection of the reversing cock a similar feed valve set for 90 lbs. By simply turning the handle of the reversing cock, therefore, the brake pipe pressure could be changed from 70 lbs. to 90 lbs. or vice versa. The pump governor at the same time was changed from the single to the duplex type, the communications being so arranged that the high or low pressure governor top was made to control the air compressor according to the position in which the reversing cock handle was placed; the high pressure governor top always controlling the compressor during an application of the brakes. This modification of the engine equipment is known as the double pressure control apparatus or schedule U. It is particularly adapted for use on heavy grades, where "empties" are hauled up grades and "loads" down. The low pressure is used, of course, with the empty cars and the high pressure cut in when the cars are loaded, at which time even the maximum percentages of braking power with the higher pressure is much less than that with the lower pressure on the light cars.

COMBINED AUTOMATIC AND STRAIGHT AIR.

With the increase in the length and tonnage of freight trains, it soon became apparent that some means of controlling the brakes on the locomotive independently of those on the train would be of great advantage, especially in heavy grade service. This led to the development and perfection, in 1900, of the combined automatic and straight air engine and tender brake equipment, also known as schedules SWA and SWB. It consists of the standard automatic arrangement previously employed on engine and tender with the addition of a straight air brake valve and a few other simple parts which permit of straight air brake applications on the engine and tender alone, without interfering in any way with the automatic brakes. When handling the locomotive alone in switching service, such an arrangement is of great assistance in quickening the movement of cars and reducing damage to lading and equipment. In the handling of long trains it provides an efficient means by which the slack of a train may be prevented from running out, thus avoiding shocks, strains or break-in-twos, resulting from an attempt to release at low speeds, changes of grade, curvature, and so on. It is also a very convenient means of obtaining a light braking power on the train when needed, as in slowing up a train, making a stop from very slow speed, to aid the retaining valves to hold the train while recharging on a heavy descending grade, or to hold the train while standing on a grade.

ET ENGINE AND TENDER EQUIPMENT.

While the various equipments mentioned possessed distinct operative advantages for the particular service for which they were designed, there were certain desirable features not provided for by any of these equipments. For example, it was impossible to prevent the loss of braking power on account of brake cylinder leakage and impossible to compensate for variation in piston travel. Moreover, the development of new equipments had taken the form of additions to or adaptions of previously existing equipments which at the same time multiplied the number of parts and occupied valuable space on the locomotive. Furthermore, the various equipments were more especially adapted for certain kinds of engines or classes of service. All of these considerations led finally to the combination of the desirable features of all former equipments in a single and simplified equipment which should at the same time include many operative functions heretofore unattainable with any equipment. This is known as the ET engine and tender brake equipment. The operation of the brakes on the cars is no different with this equipment than with former locomotive brake equip-

ments, but the engine and tender brakes can be used with or independently of the train brakes; uniform cylinder pressure is obtained on the engine and tender regardless of piston travel; cylinder pressure obtained on the engine and tender is automatically maintained, regardless of brake cylinder leakage; the engine and tender brakes can be graduated off with either the automatic or the independent brake valves, and an increased flexibility secured for service operations with increased braking power in emergency applications above the maximum obtainable in service applications. Instead of a further multiplication of parts it has been possible to reduce the number of pieces of apparatus considerably, so that in the number of operating parts the equipment is much simplified as compared with former equipments. This idea of simplification is emphasized by the adaptability of this one equipment to all kinds of engines and all classes of service, thus bringing about a uniformity desirable from all points of view. In this connection it may be stated that the ET equipment requires only slight modifications when applied to electric locomotives to provide for the requirements of double-end operation and the use of an electric pump governor and motor-driven air compressor.

TYPE K TRIPLE VALVE.

The improved types of car brake apparatus are of two classes, adapted to the particular requirements of freight and passenger service, respectively. As the demands of freight service became more severe, due to the increase in train lengths, speeds and car capacities, it became evident that certain operative features not provided by the older equipment were rapidly becoming necessities.

(1) Quick Service. To overcome the slow application of the brakes toward the rear of a long train, and the shocks and damage incident to such a difference in braking power on the head and rear ends of the train, it was necessary to provide means for obtaining a certain and uniform service application of all the brakes, and to shorten the time interval from the movement of the brake valve handle to the application of the last brake in the train.

(2) Uniform Release. To avoid break-in-twos when releasing at low speeds, caused by the retardation at the rear still continuing after that at the head end of the train has ceased, due to resulting undesirable effects, it was necsary to insure the uniform releasing of all the brakes in the train.

(3) Uniform Recharge. Also to avoid overcharging the reservoirs at the head end of the train when releasing, with the resulting undesirable effects, it was necessary to provide means for uniformly recharging the reservoirs of the entire train.

All these functions are incorporated in the type K triple valve. This valve is similar in operation to the former quick-action triple valve with the addition of (1) the quick-service feature, by means of which a supplementary reduction of brake pipe pressure takes place at each triple valve during a service reduction, similar to that during emergency applications, but less in degree. The result is a certain and quick serial service action of the brakes and consequently a uniform and much more effective braking power on the entire train, for light as well as heavy reductions, due to the fact that each brake applies and does its share of the work. Evidently this also means that the air consumption will be greatly reduced. (2) The Uniform Release feature, by means of which the release of the brakes on the head end of the train is retarded and that of the rear brakes quickened so that a uniform release is obtainable on the train as a whole; (3) the Uniform Recharge feature, which so operates as to permit more air to flow back toward the rear of the train by restricting the opening to the auxiliary reservoirs at the head end of the train. This prevents the overcharging and reapplication of the head brakes and because of the uniform recharge of the train as a whole, makes it possible to secure an approximately uniform braking power on the train should a second application be called for immediately after a release. It is plain, therefore, that while new and advantageous features have been added to those of the former quick action triple valve, all the functions of the old valve are retained, and in mixed trains the older type of valve improved in proportion to the number of new type valves present.

TYPE L TRIPLE VALVE.

Many conditions affecting the operation of passenger trains have changed since the introduction of the high-speed type of air brakes. Trains have become heavier, and speeds higher. Traffic has greatly increased so that trains must be run more frequently. Better designed trucks permit more efficient brakes to be used, and more uniform conditions as regards braking power make their use practicable. Considerations of safety demand that, on account of the higher speeds, heavier trains, and more frequent service, a braking power be used for emergency stops limited in amount only by the adhesion of the wheels to the rails. Regard for the comfort of passengers and the minimizing of the wear and tear on rolling stock; economy of time, which is of great importance where stops are frequent; and the necessity for stops being made with accuracy as well as smoothness; all these require a brake having the highest possible degree of flexibility in severe operation. In order that trains may be controlled easily and smoothly when running at either high or low speeds, and that stops may be made quickly and with the least liability of wheel sliding, the brake apparatus must provide essential features of operation. A small brake pipe reduction must give a moderate brake cylinder pressure and a moderate but uniform retardation on the train as a whole. It must be possible to make a heavy service reduction quickly, but without liability of quick action. It must be possible to graduate the release as well as the application of the brakes. To insure the ability to obtain brake applications in rapid succession and to full power, it is necessary to quickly recharge the auxiliary reservoirs. This feature also enables the engineer to handle long trains in heavy grade work with a much greater factor of safety than heretofore, and eliminates the need for retaining valves.

For high speed trains a high brake cylinder pressure available for emergency applications is imperative, in order to provide a maximum braking power when the shortest possible stop is required to save life or to avoid accident.

These requirements have been met by the type L triple valve, which is similar in operation to the former type of quick-action triple valve, with the addition of the following features: Quick recharge of auxiliary reservoirs by which a rapid recharging of the brake system is secured, thereby maintaining an approximate equality of pressure on the auxiliary reservoir and brake pipe sides of the triple valve piston, thus making it possible to obtain full braking power immediately after a release has been made and permitting as many applications and releases in quick succession as may be desired, without materially depleting the system. Graduated release, which permits of partially or entirely releasing the brakes on the entire train. High emergency cylinder pressure, which greatly increases the available braking power in emergency applications over the maximum obtainable with a full service reduction. With this, as with all quick-action triple valves, a portion of the air contained in the brake pipe is vented to the brake cylinder in emergency applications, thus providing for the quick serial operation of the brakes in the usual way. This, in itself, increases the brake cylinder pressure thus obtained considerably above the maximum possible in ordinary service applications. The high emergency pressure feature referred to still further increases this emergency pressure and the high cylinder pressure thus obtained is retained without reduction until released. A supplementary reservoir is used in addition to the ordinary auxiliary reservoir, the function of which is to assist in obtaining the graduated release of the brakes and the high emergency cylinder pressure.

Electrical Department

Steam and Electricity Compared.

By W. B. Kouwenhoven, E.E., M.E.

In any railroad problem where the number of stops is large, the speed varies widely from time to time. The train starts from the station and at first rapidly increases or accelerates in speed, then more and more slowly until practically a uniform speed is reached. This period is known as the period of acceleration. The uniform speed or running speed, as it is called, is continued until the power is shut off and the train allowed to coast or drift ahead. During the period of coasting the speed decreases slowly. Then the brakes are applied and the train brought quickly to a stop at the next station. This process in train performance is repeated again and again and forms a regular cycle of events. The shorter the time required for each cycle, the higher the schedule speed.

The schedule speed of a train is the number of miles an hour covered by the train. If a train covers nine miles in thirty minutes, including the time spent in stops at stations for unloading and loading passengers, the schedule speed of the train is 18 miles per hour. In other words, the schedule speed for a given run is the average speed of the train for the entire run expressed in miles per hour.

The higher the schedule speed the more trains there are per hour and this means an increased capacity for the road. For example, suppose that the arrangement of the blocks permit the operation of a train every half mile. With a schedule speed of 15 miles per hour it would be possible to run thirty trains an hour, or a train every two minutes passing a single point on the line. And for every half mile increase in schedule speed, there would be an additional train per hour. The number of trains leaving a station in an hour is called the frequency of service.

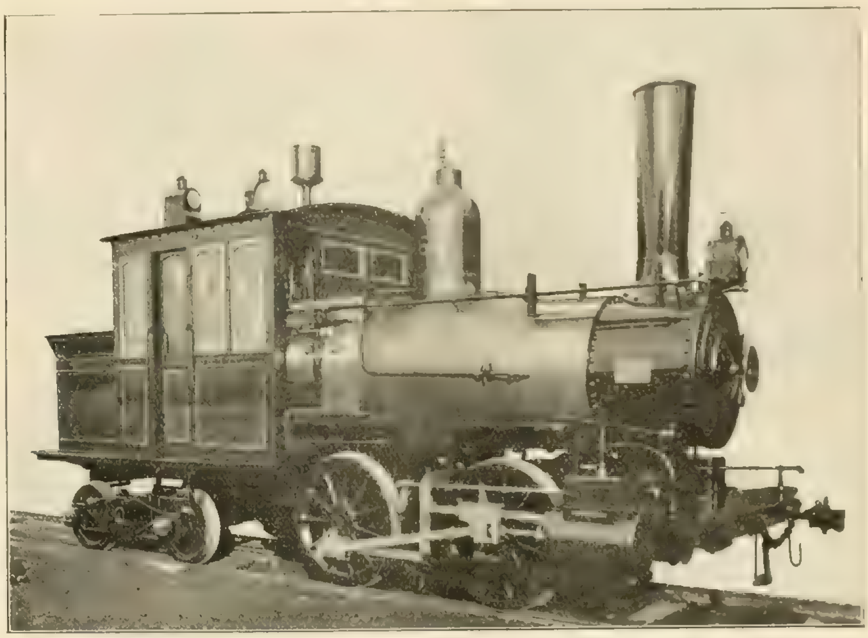
In such a problem as was presented to the Manhattan Elevated Roads in 1900, where there are a large number of stations at more or less regular intervals, the cycle of events was of necessity repeated a great many times in a single trip. There were also a very large number of passengers to be carried, and every six-car train added meant approximately an increase of six hundred passengers carried to their destination.

In order to increase the carrying capacity of a line several things are possible: First, the trains may be run at a higher schedule speed; second, the length of the blocks may be shortened; third, the length of the train may be increased. In this comparison only the first method, that of increasing the schedule speed, will be considered. In the addition of cars to the train, electricity has an advantage over steam, because with the use of the multiple unit system of control the length of the train is only limited by the length of the station platforms. In fact, since the adoption of electricity, the average length of the train has increased from 3.8 cars in the days of steam to 5.3 cars with the present electrical equipment.

A number of changes may be made that will increase the schedule in any given case, but in this comparison only two will be discussed. First, that of increasing the rate of acceleration, thus shortening the time required to reach the uniform speed; second, that of increasing the running speed.

The running speed of a train is the velocity at which it travels after the speed has reached practically a constant value. For instance, if the running speed of a train is 30 miles an hour, then it would travel 30 miles in an hour if the speed were maintained constant for that length of time. The value of the running speed depends upon the force exerted at the tread of the driving wheels at that speed, and upon the weight of the train. This force is known as the tractive effort, and is measured in pounds pull.

The remaining change to be considered is the rate of acceleration. Acceleration is the rate of change of velocity. For example, if the above mentioned train reaches its uniform speed of 30 miles an hour, in one minute its rate of acceleration would be one half mile per hour, per second. Or the velocity of the train would increase one half mile per hour, each second for the first minute. At the end of thirty seconds the train would be running at a speed of 15 miles an hour. The rate of acceleration also depends upon the force or tractive effort exerted at the tread of the driving wheels during the period of acceleration and upon the weight of the train. The tractive effort may be defined as the force that the driving power, whether it be steam or electricity, exerts at the tread of the driving wheels.



FORNEY ENGINE, AT ONE TIME USED ON THE MANHATTAN ELEVATED.

Therefore as both the running speed and the rate of acceleration depend upon the tractive effort that the equipment can produce, with a given weight of train the one that gives the greatest tractive effort per unit train weight will give the highest schedule speed. This reduces the comparison of steam and electricity on the Manhattan Elevated roads to a comparison of the tractive efforts per ton produced by the locomotives that were used from 1872 to 1902 and that of the motor cars of the present day. The one that gives the highest tractive effort per ton would increase the capacity of the road the most.

The locomotives used were the Forney

type and were what are called 0-4-4 engines. They were operated under very favorable conditions, were not overloaded, were of simple construction and were well maintained. The boiler was of wagon-top extended type, and had a heating surface of 498 sq. ft. The ratio of the heating surface to the grate area was as 50 to 1. They carried a steam pressure of 130 to 135 lbs. The cylinders were 12 x 16 ins. and the diameter of the driving wheels was 42 ins. The locomotives had a total weight of 46,930 lbs.; of this 31,200 lbs., or 66.5 per cent., was carried on the drivers.

The tractive effort in pounds for a steam locomotive is equal to the cylinder diameter in inches squared, multiplied by the mean effective pressure in pounds, and the stroke in inches, the product divided by the diameter of the driving wheels given in inches. Expressed as a formula it is:

$$T = \frac{d^2 \times S \times P}{D}$$

Where T = tractive effort in pounds.
d = diameter of cylinder in inches = 12
P = mean effective pressure in pounds.
S = stroke in inches = 16
D = diameter of drivers in inches = 42

When starting from a station and during the early part of acceleration the valve has its full travel and is open for about 14 ins. of piston travel. The mean effective pressure would then equal about 85 per cent. of 135 lbs., or 115 lbs. Taking 85 per cent. of the boiler pressure is in accordance with the rule of the Master Mechanics' Association, and substituting the proper values in this formula we have:

$$T = \frac{(12)^2 \times 115 \times 16}{42} = 6{,}310 \text{ lbs.}$$

This is the tractive effort at starting that is produced by the engine. The tractive effort per ton equals

$$\frac{6310}{23.5} = 268.5 \text{ lbs.}$$

This ratio between the tractive effort and the weight on the drivers is 4.95.

The engine can maintain this tractive effort only at the very low starting speeds, because as the speed increases the wheels revolve faster and the boiler could not economically supply the demand for the larger consumption of steam if high speed could be maintained with the late cut off used at the start. Therefore the engineer shortens his valve travel by notching up the reverse lever, thus bringing his cut-off earlier in the stroke as the train gains speed. This smaller quantity of steam reduces the mean effective pressure and therefore lowers the tractive effort. At a speed of 16.5 mils an hour, and with a cut-off at one-third stroke the engine exerts a tractive effort 3,200 lbs., or 136.1 lbs. per ton.

The motor employed in the present electrical equipment is manufactured by the General Electric Co., and is known to the trade as the G. E.-66, railway motor. The motor is a four-pole series 500 volt railway motor and is rated at 125 h. p. The motor is attached to the truck by what is known as the noose suspension. The driving pinion has 16 teeth, the gear on the axle 61 teeth, making the gear ratio 61 to 16, or 3.81. The wheels of the motor car are 33 ins. in diameter. The motor weighs 4,000 lbs. and there are two motors to each motor car, both motors being mounted on the same truck. The total weight of the car, including the two motors, is 61,000 lbs. Of this, 34,500 lbs., or 56.5 per cent. of the total, is on the driving wheels. The apparatus for the motor control and its operation was described in the December, 1907, issue of RAILWAY AND LOCOMOTIVE ENGINEERING.

The tractive effort produced at the tread of the car wheels depends upon the torque developed by the motor. The term torque and its meaning was explained in our last month's issue. The torque of the motor is transmitted by means of the gearing to the rim of the wheel. The average efficiency of the gearing is practically 95 per cent. The tractive effort in pounds developed by the motor equals 24 multiplied by the number of gear teeth, multiplied by gear efficiency, multiplied by the motor torque in pounds, the product divided by the number of pinion teeth times wheel diameter in inches. This gives the tractive effort. Expressed as a formula it is:

$$T = \frac{24\ G\ e\ q}{P\ D}$$

Where T = tractive effort in pounds
G = number of gear teeth = 61.
e = gear efficiency = 95 per cent.
q = torque of the motor in pounds.
P = number of pinion teeth = 16.
D = wheel diameter in inches = 33 ins.

During acceleration the motor takes a current input of 275 amperes and develops a torque of 1,730 lbs. Substituting in the formula:

$$T = \frac{24 \times 61 \times .95 \times 1730}{16 \times 33} = 4{,}550 \text{ lbs.}$$

This is for one motor only, and as there are two motors to each motor car, there will be twice the tractive effort, or a total of 9,100 lbs. for the car. The tractive effort per ton is

$$\frac{9100}{30.5} = 298.36 \text{ lbs.}$$

This gives a tractive effort of 29.86 lbs. per ton in favor of the electric motor during the period of acceleration. The ratio between the tractive effort and the weight on the driving wheels is 3.8.

The motor only develops this torque during acceleration. The speed rises after the starting resistances are entirely out of circuit and the current falls, until at 16.5 miles per hour, each motor is producing a tractive effort of 2,300 lbs., or a total of 4,600 lbs. for the two motors. This is equivalent to 150.8 lbs. per ton as against 136.1 lbs. per ton for steam at this speed.

This advantage in tractive effort of 29.86 lbs. per ton in favor of electric traction is greater than at first sight. The locomotive pulled usually a four-car train. The weight of each passenger coach was about 15. tons, making a total train weight of 83.5 tons including that of the engine. To start this load the locomotive could only produce at its maximum a draw-bar pull of 7,000 lbs., which would give an acceleration of about .8 miles per hour per second. On the other hand a 5-car motor train, consisting of 3 motor cars and 2 trailer cars, each trailer weighing 18.7 tons, has a total weight of 129 tons. The three motor cars will develop a tractive effort of approximately 27,000 lbs., which will produce an acceleration of about 2 miles per hour per second, as against .8 miles per hour per second for the steam locomotive. The schedule speed maintained by the electric equipment is 15 miles per hour, as against approximately 12.95 miles per hour in the days of the steam locomotive.

Electricity also has some additional advantages. It is much cleaner than the steam engine and there is an entire freedom from smoke which is a very important advantage in a city. The locomotive contains unbalanced reciprocating parts in the form of rods and cranks. These unbalanced parts produce vibration and what is called a hammer blow on the rails. The tractive effort of the locomotive is not constant, but varies widely, depending upon the steam pressure in the cylinders and upon the position of the cranks. When it is at its highest there is a tendency to start the drivers slipping. On the other hand the motor is free from unbalanced parts and its torque is contantly and continuously applied to the wheels.

When a steam locomotive is standing at a station or on a siding it is burning coal. A motor car when lying idle does not consume power.

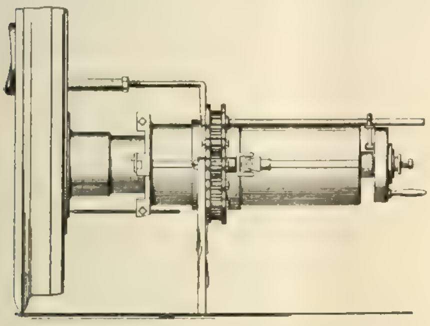
From an accurate record of the duration of all delays taken for the months from November, 1900, to March, 1901, when steam was employed, and for the corresponding months of 1905-1906, with electricity, it appears that for the five months with steam operation the total car mileage was 18,527,773 miles and the total delay 8,258 train minutes. The car mileage per train minute delay was 2,243 miles. For the corresponding period with electric traction the total car mileage was 25,482,081 miles and the total delay 5,970 train minutes, or a car mileage of 4,268 miles per train minute delay.

It must be remembered that the months involved are those in which the difficulties of operation due to weather conditions and the number of passengers carried are at the maximum.

Patent Office Department

CRANK PIN TURNING MACHINE.

A crank-pin turning machine has been patented by M. H. Westbrook, Port Huron, Mich., No. 884,966. It comprises a cylindrical bed for attachment to the outer end of a crank pin, a cylindrical tool carriage mounted to turn on and to slide axially on the bed, gearing for turning the tool carriage, the carriage

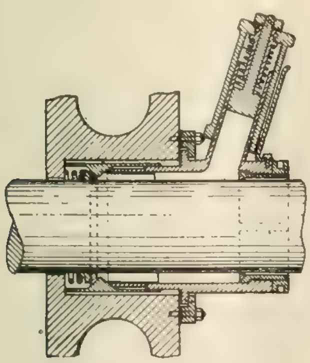


CRANK-PIN MACHINE.

having guided movement in the hub of one of the gears. There is also means for feeding the tool carriage. The machine can be readily operated either by hand or power.

STUFFING BOX.

An improved stuffing box has been patented by F. A. Dailey, St. Paul, and B. Long, Minneapolis, Minn., No. 884,318. The device consists of a stuffing box of the usual kind to which is added a chamber communicating with the interior of the box and extending outwardly therefrom, the chamber being adapted to hold a reserve supply of

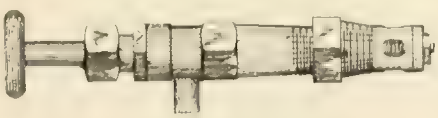


IMPROVED STUFFING BOX.

plastic packing, and a screw operated ram working within the chamber, adapted to force a supply of the stored packing into the stuffing box.

GAUGE COCK.

An improved gauge cock for boilers has been patented by J. J. Finnegan and C. E. Webster, Benwood, W. Va., No. 880,786. The chief feature of the device is an automatic attachment which admits of the removal of a gauge cock without a resultant exhaustion of steam from the boiler. As will be seen

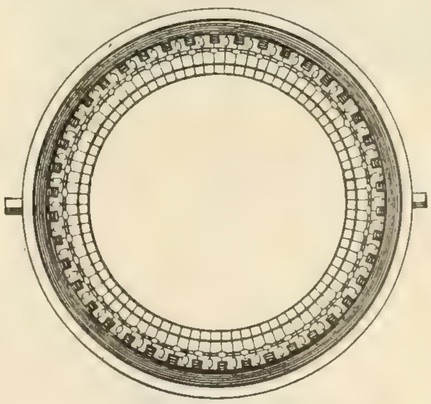


AUTOMATIC GAUGE COCK.

from the accompanying illustration the gauge cock is provided with a tapered threaded socket, which extends into the boiler and is provided with one or more ports. A coiled spring in this socket keeps a valve open when the gauge cock is in place and closes the valve when the gauge cock is withdrawn.

CAR WHEEL CHILL.

A patent has been granted to Mr. B. M. Carr, superintendent Dickson Car Wheel Co., Houston, Texas, for an improvement in contracting car wheel chill. The device consists of a series of segments, made right and left, with dove-tail ends, placed together to form a circle with a small



CHILL MOLD FOR CAR WHEELS.

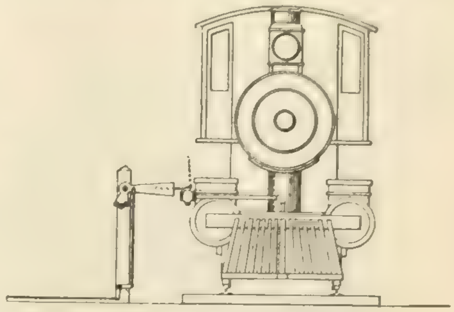
spacing strip on face for the purpose of forming the slots, also for relieving the gases from the mold. There is a ring of metal cast around the dovetail end of the segments which binds them all together. No machine work is necessary except to bore out the proper diameter of the wheel so that the chill can be speedily put in use. The inventor claims an important degree of economy in time and labor.

BRAKE SHOE.

Mr. W. B. Goodwin, Columbus, Ohio, has patented a brake shoe. No. 882,107. It comprises a back member, a single integral shell member having back, side and end walls, a filling therefore formed of a composition of matter adapted to engage frictionally with a wheel. There are bolts embedded in the composition extending outwardly through the back member to secure the shell member removably thereto.

BRAKE OPERATING DEVICE.

An automatic air brake operating device has been patented by E. M. Cain,

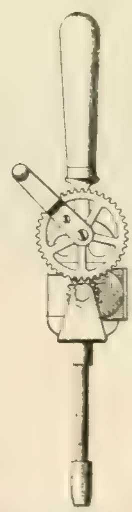


STOP SIGNAL DEVICE.

Wilmington, Del. No. 882,372. The device comprises an air brake controlling angle cock arranged adjacent to one side of the train and embodying an operating lever adapted to be raised and lowered, and a signal embodying an arm adapted to be set in the path of movement of the lever to turn it and operate the angle cock when the lever is in its operative position.

VALVE-SEAT GRINDER.

F. Kopriva, New York, N. Y., has patented a valve-seat grinder, No. 886,002. The device consists of a frame carrying rotatable mechanism, a chuck



VALVE SEAT GRINDER.

spindle with attached gearing. There is also a rack, and an eccentric engaging the rack, and means for regulating the orbit of rotation of the eccentric.

Historic Locomotives at Purdue.

By Robert C. Schmid

There are, at present, but two important collections of old locomotives in the United States. One of these is,

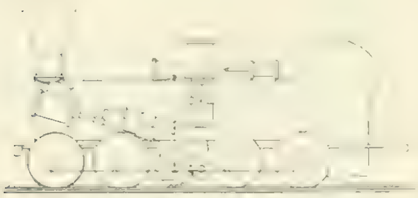


FIG. 1. ENGINE USED ON THE MADISON INCLINE.

of course, the notable collection belonging to the Baltimore & Ohio Railroad; the other is at Purdue University, Lafayette, Ind. The locomotives in the Purdue museum cover a variety of

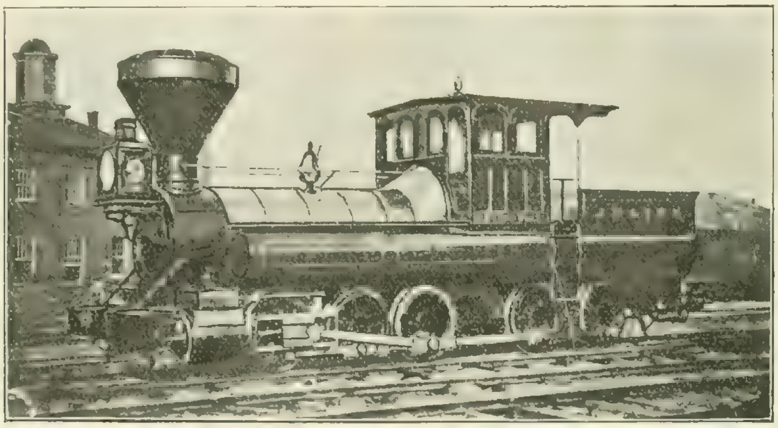


FIG. 2. THE "RUBEN WELLS," BUILT IN 1868.

types, largely those which have performed unusually good service in their day, or which are of particular interest on account of an especial design, representing the work of some well known builder. The locomotives include the "Reuben Wells," of the old Jeffersonville, Madison & Indianapolis Railroad, now a part of the Pennsylvania Lines; the "Daniel Nason," which belonged to the Boston & Providence, now a part of the New York, New Haven & Hartford; Engine 173, an old Baltimore & Ohio Hayes ten-wheeler; an American type locomotive, formerly No. 1040, of the Chicago & North Western Railway; an especially designed English locomotive, the "James Toleman," exhibited at the Columbian Exposition in 1893, and a full-sized wooden model of the "Tornado," of the old Raleigh & Gaston, now included in the Seaboard Air Line Railway.

Undoubtedly, the most noted locomotive in the group is the "Reuben Wells," which came to the University in 1906. It was used in pushing service on the Madison incline, and recalls an interesting history. When the Madison & Indianapolis Railroad was opened, in 1847, it was decided to operate the inclined plane at Madison, by means of the rack system. This incline has a 6 per cent. grade, extending a distance of three miles out of the city of Madison, Ind. Accordingly, a locomotive, the "M. G. Bright," Fig. 1, was ordered from M. W. Baldwin & Co. in 1847, to work the incline. A second, the "John Brough," followed in 1850. Except for the cog arrangement, the engines were very similar to Mr. Baldwin's standard 8-wheel connected engine of the time. The drivers were 42 ins. in diameter, and the cog-wheel was worked by 17 by 18-in. cylinders set vertically over the boiler. The cog-wheel could be raised out of contact with the rack, when not in use, and the locomotive used like any other engine. But this arrangement had its drawbacks. Often, while ascending the steep grade, the cog would become disengaged from the rack, and the entire train would go thundering down the hill. At the bottom of the incline there was a sharp curve, after which the road paralleled the Ohio River. The train, in its rapid descent, would either go off into the river, at the foot of the incline, or else be piled up against one of the surrounding buildings.

These cumbersome and uncertain engines soon became a detriment to the ever increasing traffic of the road. In the year 1868 (the road was then known as the Jeffersonville, Madison & Indianapolis, through a consolidation of the old Madison & Indianapolis and the Jeffersonville Railroad) Mr. Reuben Wells designed and had built, at the Jeffersonville shops of the company, the locomotive "Reuben Wells," No. 35, Fig. 2, which is now in the museum. Few persons had thought of abandoning the rack-rail, and depending on adhesion of the driving wheels to the rails alone, but Mr. Wells made bold plans and was successful. The performance of the engine attracted attention far and wide. The editor of London "Engineering," to whom Yankee genius was still new, would not believe that so steep a grade could be operated without the use of the rack, until he sent a representative to Madison to investigate.

From Mr. Wells' report on the engine is obtained the following description: "Some of the dimensions of the engine are as follows: Cylinders, 20x24 ins.; the drivers consist of five pairs, all of them coupled and all 49 ins. in diameter. No truck is used under the engine, all of the wheels being drivers; the boiler is 56 ins. in diameter, is of heavy 7/16 in. iron, and has 201 iron tubes, 12 ft. long and 2 ins. in diameter. The firebox is 5 ft. 8 ins. deep, 5 ft. 3 ins. long, 4 ft. wide at the top and 3 ft. at the bottom, having a heating surface of 116 sq. ft., while the heating surface of the tubes is 1,262 sq. ft. It is what is commonly called a tank engine; that is, carrying the water and fuel on the frame and wheels of the engine proper, the tank holding 1,800 gallons of water.

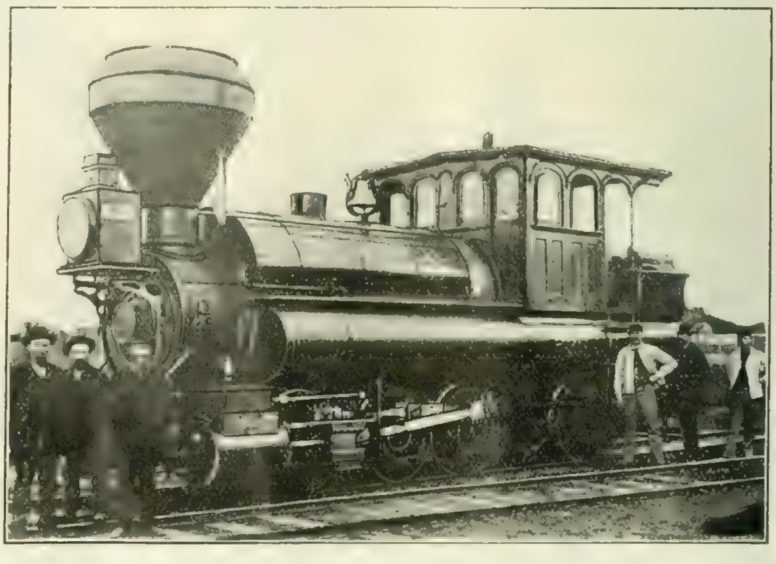


FIG. 3. THE REMODELED ENGINE, "RUBEN WELLS."

The weight of the engine with fuel and water is 112,000 lbs. The cylinder power, with an average effective pressure in the cylinders of 100 lbs. per sq. in., is capable of exerting a tractive force of 21,818 lbs. on a level road, less the friction of the working parts of the engine itself."

FIG. 4. THE "DANIEL NASON."

Some years later the engine was rebuilt, in part, Fig. 3, the number of driving wheels being decreased to four pairs. A portion of the coal and water space at the rear was cut off, and a saddle tank was placed on the boiler. The J., M. & I. R. R. was absorbed by the Pittsburgh, Cincinnati, Chicago & St. Louis, in 1873, and the "Reuben Wells" became No. 635 of that road. One of the old rack-rail locomotives, the "M. G. Bright," was rebuilt on similar lines to the "Reuben Wells." It exploded its boiler in 1877. The "Reuben Wells" was in constant use until a few years ago, when the company decided to retire her. The incline is at present worked by a powerful eight-coupled side tank locomotive, built in 1896. Before sending the "Reuben

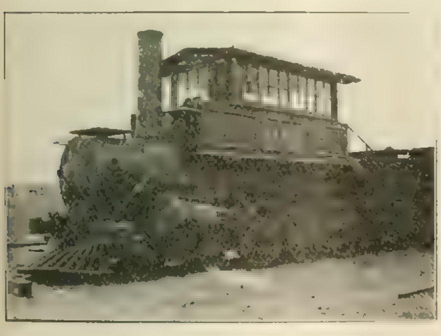


FIG. 5. OLD B. & O. TEN-WHEELER.

Wells" to Purdue, the Pennsylvania people restored her to her original form, as nearly as possible, and resplendent in a bright coat of paint, her appearance is not unlike that when she rolled forth from her shop in July, 1868.

The "Daniel Nason" is one of the few inside-connected American-type locomotives still in existence. It was built in 1858, at Roxbury, Mass., by Mr. George N. Griggs, master mechanic of the Boston & Providence Railroad. This engine, Fig. 4, doubtless recalls to the minds of many old railroad men the inside-connected locomotives common in the New England States in the 50's. Another famous insider of the old Boston & Providence was the "New York," built by Mr. Griggs in 1851. It had a diamond stack, of which Mr. Griggs was the inventor. "The Nason" is an eight-wheel, 4-4-0 type engine, with 16x20-in. cylinders inside the frames, and connected to the forward driving axle, which is cranked. The engine weighs 52,650 lbs., has 54-in. driving wheels, and truck wheels 30 ins. in diameter. In the driving wheels, a circle of wooden blocks about 1 in. thick, as was the practice of that time, is employed between the centres and tires of the wheels. Steam pumps, operated by the crossheads, were used to supply water to the boiler, and the bell hung between the two old-time safety valves seems odd to us nowadays. A cast plate on the dome reads, "B. & P. R. R., July, 1858, Geo. N. Griggs, machinist." The tender is carried on three pairs of wheels set in rigid pedestals. The locomotive was deposited with the University, in 1905, through the courtesy of Mr. Samuel Higgins, general manager of the New York, New Haven & Hartford.

Old B. & O. Engine No. 173 is particularly interesting on account of its historical connection with the Winans camelbacks. This locomotive is often improperly spoken of as a Winans camelback engine, but strictly speaking it is neither a Winans engine nor a camelback; in fact, it was a type which Mr. Winans was very much opposed to. Engine 173, Fig. 5, is correctly known as a Hayes ten-wheeler, the type having been originated in 1853 by Mr. Samuel J. Hayes, master of machinery of the Baltimore & Ohio; it was thought that the Winans engines were too hard on the track and curves. The Hayes and Winans engines differed, in that the former were of ten-wheel or 4-6-0 type, while the latter were eight-coupled, without trucks. The Hayes ten-wheelers are sometimes referred to as the camelback type, on account of the location of the cab on top of the boiler, near the middle, and the sloping rear end of the boiler, the same as in the Winans engines.

The first locomotive of Mr. Hayes' design was constructed in 1853 by W. Dunmead & Co., of Baltimore. Many more followed, until 1857, when their construction ceased for a time. For some reason the type was again revived in 1868 by Mr. John C. Davis, M. M., who had a lot of them built at the Mount Claire shops of the company. Engine 173 is one of this latter lot. The principal dimensions are as follows: Cylinders 19x22 ins.; driving wheels 50 ins. in diameter, the driving wheel base being 8 ft. 10 ins.; truck wheel 28 ins. in diameter, total weight of engine is 77,100 lbs., of which [illegible] lbs. is on the drivers, firebox 42 ins. by [illegible] ins.; grate area 17.39 sq. ft.; the boiler contains 132 tubes 2½ ins. in diameter, 13 ft. long, and the total heating surface 1,170.01 sq. ft. The engine came to the University in November, 1901, after a five-day trip from Baltimore under its own steam, it having been in service until a few days before its departure. It was presented to the Purdue museum through interest shown by Mr. J. N. Barr, F. D. Underwood and F. D. Casanare, of the Baltimore & Ohio.

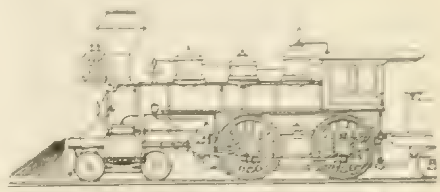


FIG. 6. BALDWIN ENGINE OF 1873.

The Chicago & North Western American-type locomotive is a class which was common for passenger service in the 70's and 80's. It was built in 1873 at the Baldwin Locomotive Works. The engine has been changed somewhat since building. Fig. 6 shows it as originally built, by increasing the length of the smoke box and substituting a straight stack for the diamond stack, as in Fig. 7. The engine is a 16x24, with 62-in. drivers, and truck wheels 26 ins. in diameter. The total weight of the locomotive is 72,000 lbs. The boiler is 4 ft. in diameter at the front ring, is provided with 134 2-in. tubes 10 ft. 10 ins. long, and has 780 sq. ft. of heating surface. The firebox measures 65x34½ ins. The engine was

FIG. 7. C. & N. W. 4-4-0 TYPE.

sent to Lafayette soon after its retirement from active service.

The locomotive "Tornado," Fig. 8, a wooden model of which is in the museum, was the second engine owned by the Raleigh & Gaston, a parent line of the present Seaboard Air Line Railway. The original engine was imported from England in 1840, and Mr. Albert Johnson, who was the first engineer to run the engine, supervised the construction of the model. It has inclined cylinders 9x20 ins. and a single pair

of driving wheels 54 ins. in diameter, placed in front of the firebox, which is circular, and is surmounted by the well known Bury haystack dome. The boiler is 34 ins. in diameter. The valves were actuated by hook motion. The

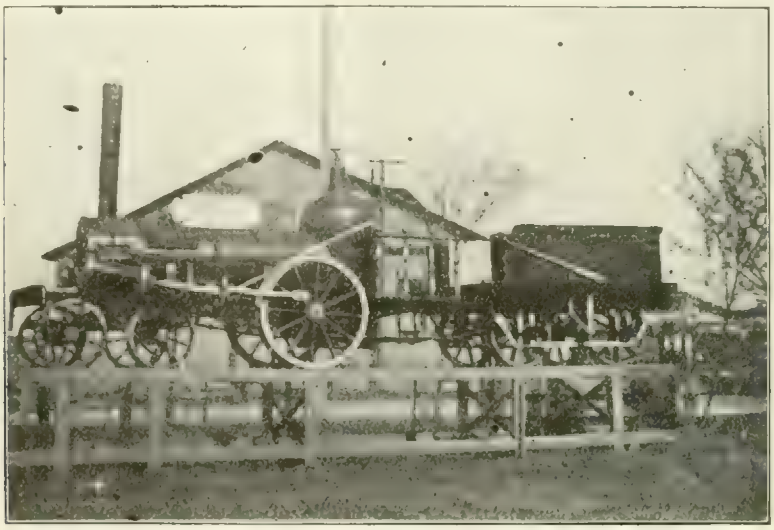


FIG. 8. THE "TORNADO," SECOND ENGINE ON THE SEABOARD AIR LINE RAILWAY.

model was presented to the University in 1902, by the Seaboard Air Line, as a result of the interest shown by Mr. R. P. C. Sanderson, superintendent of motive power, and Mr. J. N. Barr, general manager.

The "James Toleman," Fig. 9, is an English-built locomotive and was exhibited at the Columbian Exposition in 1893. It was designed by Mr. F. C. Winby, of London, and was constructed by Hawthorne, Leslie & Co., of Newcastle, England. In many ways the "James Toleman" represents somewhat radical departures from ordinary practice. The peculiar construction of the boiler is the first thing which an observer notices, it being elliptical in section, in order to fit between the un-

FIG. 10. AN EARLY COACH ON THE B. & P.

usually large driving wheels. It consists of two intersecting circles 50 ins. in diameter, the centres of the circles being 17 ins. apart. Cross stays are employed to strengthen the boiler across the flat portions in the middle. The firebox is 8 ft. 3¾ ins. in length, 3 ft. 4½ ins. in width, and of unusual depth. The tubes, instead of terminating at the forward end of the firebox as in common practice, project into the firebox a certain distance, in order to secure greater length. The lower part of the firebox is of copper, ½ in. thick, and the upper portion of ⅝ in. steel. Besides having a freakish boiler, the locomotive is burdened with still another peculiarity. Four cylinders are arranged in two pairs to drive independent axles. Two of them are 17x22 ins., are inside the frames, being attached to the forward driving axle, which is cranked; the other two, 16½x24 ins., are outside the frames and inclined slightly, being connected to the rear pair of drivers. This arrangement necessitates the use of a very long piston-rod to reach the guides on the outside connections. The valves of the inside cylinders are controlled by the Stephenson link motion and those for the outside cylinders by the Joy valve gear. The engine weighs 120,000 lbs., with 70,000 lbs. on the drivers, which are 90 ins. in diameter; the truck wheels being 49 ins. The boiler has 2,000 sq. ft. of heating surface, 1,817.4 sq. ft. in the tubes, which number 134, and are 2 ins. in diameter and 14 ft. 9¾ ins. long, and 182.6 sq. ft. in the firebox.

The workmanship and materials employed in the construction of the "James Toleman" are the best that could be had. At the close of the exposition at Chicago, the engine was placed in service on the Chicago, Milwaukee & St. Paul, where it failed to steam porperly or to prove equal to other engines of its class. A description of this locomotive, together with a letter from the superintendent of motive power of the Chicago, Milwaukee & St. Paul regarding the performance of the engine on that road was published in the November, 1907, issue of RAILWAY AND LOCOMOTIVE ENGINEERING. After the failure of the "James Toleman" to perform properly on the C., M. & St. P., the officials presented the engine to the Purdue museum. Another weak point about the locomotive was the fact that it was very much more rigid than the American locomotive. Much trouble was experienced in delivering the engine, as it left the track repeatedly, when it encountered some of the numerous curves of the Purdue switch.

Besides the locomotives, the museum contains several other features. One of these is an early coach of the Boston & Providence Railroad, Fig. 10. It was built in 1834, and was at one time drawn by horses between Dedham and Readville, Mass. It ran for a long time between Boston and Dedham. There are also in the museum a full-sized smokebox and cylinder casting of a Richmond compound, a full-sized

FIG. 9. THE "JAMES TOLMAN."

sectional model of a piston-valve, exhibited by the American Locomotive Company at the St. Louis Exposition; an old walking-beam steam engine, several types of car trucks, several forms of old rails and ties, and numerous other small articles of historical value.

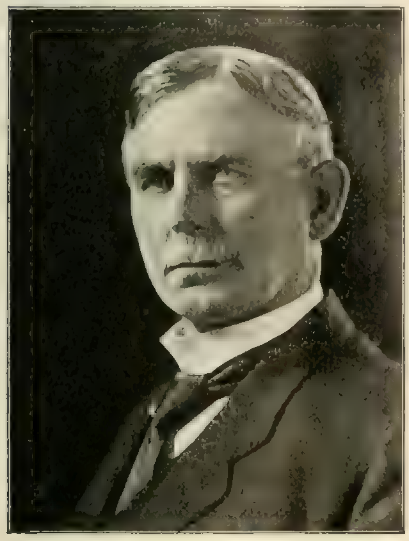
The collection is at present housed in a large temporary wooden building, but it is hoped that, in the near future, a suitable building will be provided.

Correction does much, but encouragement does more. Encouragement after censure is as the sun after a shower.—*Goethe.*

Items of Personal Interest

M. M. and M. C. B. Officers.

This month we have the pleasure of presenting the portraits of the officers of



WILLIAM M'INTOSH
President M. M. Association

the American Railway Master Mechanics' and Master Car Builders' Associations. The conventions are held this year at Atlantic City from the 17th to the 24th of

H. H. VAUGHAN
Vice Prest. M. M. Assn.

June. The president of the Master Mechanics' Association is Mr. William McIntosh, Superintendent of Motive Power of the Central Railroad of New Jersey. The three vice-presidents of the Association, in the order of their election, are Mr. H. H. Vaughan, Assistant to the Vice-President of the Canadian Pacific Railway; Mr. George W. Wildin, Mechanical Superintendent of the New York, New Haven & Hartford Railroad, and Mr. F. H. Clark, General Superintendent of Motive Power of the Chicago, Burlington & Quincy Railroad. Mr. Angus Sinclair, Chief Editor of RAILWAY AND LOCOMOTIVE ENGINEERING, is Treasurer of the Master Mechanics' Association.

The president of the Master Car Builders' Association is Mr. G. N. Dow, General Mechanical Inspector of the Lake Shore & Michigan Southern Railway. The vice-presidents of the Association, in the order of their election, are Mr. R. F. McKenna, Master Car Builder of the Del-

GEO. W. WILDIN
Vice Prest. M. M. Assn.

aware, Lackawanna & Western Railroad; Mr. R. W. Burnett, Assistant Master Car Builder of the Canadian Pacific Railway; Mr. T. M. Ramsdell, Master Car Builder of the Chesapeake & Ohio Railway. Mr. John Kirby of the Lake Shore & Michigan Southern, is the Treasurer of the Association, and Mr. Joseph W. Taylor, Chicago, is the permanent Secretary of both the M. M. and the M. C. B. Associations.

Professor Ira O. Baker, who has been for 34 years connected with the department of civil engineering of the University of Illinois, has been granted by the trustees, leave of absence for one year from July 1st, 1908. It is understood that Prof. Baker will devote himself to the work of revising his well-known book on "Masonry Construction." The executive duties of the department of civil engineering will be assumed by Prof. J. P. Brooks.

Mr. Chas. Conlisk, who has represented the interests of the injector department of William Sellers & Co., Inc., so faithfully in the Middle West for many years, has been compelled to sever his connection with the company on account of ill health.

F. H. CLARK
Vice Prest. M. M. Assn.

Mr. W. F. Perdue, late instructor in standard rules for the Chicago & Alton, has been appointed to a similar position with the Mexican Central.

ANGUS SINCLAIR
Treasurer M. M. Assn.

Mr. Clinton B. Conger, until recently connected with the International Correspondence School, has been appointed to represent the interests of

William Sellers & Co., Incorporated, of Philadelphia, in the States of the Middle West. Mr. Conger's appointment is in the injector department of this well-known firm and he will continue to call on many of his old friends in his new capacity. Mr. Conger was

JOHN KIRBY
Treasurer M. C. B. Assn.

at one time connected with the editorial staff of RAILWAY AND LOCOMOTIVE ENGINEERING and is well known to our readers.

Mr. Chas. J. Birchfield, in charge of the advertising department of the Santa Fe Gulf Lines, with headquarters at Galveston, has been promoted to advertising manager of the western di-

R. F. M'KENNA
Vice Prest. M. C. B. Assn.

vision of the Santa Fe system, at Los Angeles, Cal.

The Canadian Railway Club has elected officers for the ensuing year as follows: President, Mr. L. R. Johnson, assistant superintendent of motive power of the Canadian Pacific; vice-president, Mr. H. H. Vaughan, assistant to the vice-president of the Canadian Pacific; second vice-president, Mr.

G. N. DOW
President M. C. B. Assn.

A. A. Maver, master mechanic Grand Trunk System; executive committee, Messrs. J. H. Calahan, James Coleman, A. A. Goodchild, T. McHattie, A. W. Wheatley and W. N. Dietrich; secretary, Mr. James Powell; treasurer, Mr. S. S. Underwood.

Mr. A. L. McIntosh, formerly general foreman on the Illinois Central at

W. R. BURNETT
Vice Prest. M. C. B. Assn.

McComb, Miss., has been appointed division master mechanic on that road, with headquarters at East St. Louis, Mo., vice Mr. H. C. Eich, transferred.

Mr. Kepler Johnson has been appointed assistant superintendent, first and second districts, fourth division of the Denver & Rio Grande Railroad, with headquarters at Alamosa, Colo.

Mr. George L. Wall, chief engineer of the Lima Locomotive Works, has been retained by the committee on Per Diem of the American Railway Association to compile the data upon which their report will be based.

Mr. Edward C. Rutherford has been appointed manager of the newly opened

JOS. W. TAYLOR
Secretary M. M. and M. C. B. Assns.

office and works of The Goldschmidt Thermit Company in Toronto, Can. The new branch was opened for business May 1st. Mr. Rutherford is a Canadian by birth, and has a wide acquaintance among the business men of the Dominion, having been for several years manager of the Magann Air Brake Com-

T. M. RAMSDELL
Vice Prest. M. C. B. Assn.

pany, and also of the Canadian Brake and Supply Company.

Mr. Wm. Renshaw has resigned as superintendent of machinery of the Illinois Central, after 43 years' service. He commenced his service in the drawing office of that road in 1865 and worked his way up to superintendent of machinery.

Mr. G. W. Murphy has been appointed chief train dispatcher on the D., L. & W., vice Mr. F. M. Benning, promoted.

Mr. F. M. Benning has been appointed passenger train master on the Lackawanna, vice Mr. Frank Cizek, transferred.

Mr. C. C. Foltz has been appointed assistant superintendent on the Delaware, Lackawanna & Western, vice Mr. J. G. Sickles, resigned.

Mr. J. Archibald has been appointed locomotive foreman on the Canadian Pacific Railway at Field, B. C., vice Mr. A. W. Clark, transferred.

Mr. R. J. Turnbull has been appointed master mechanic on the Illinois Central Railroad with headquarters at Waterloo, Ia., vice Mr. R. W. Bell, promoted.

Mr. H. C. Eich has been appointed master mechanic on the Illinois Central Railway with headquarters at Paducah, Ky., vice Mr. J. H. Nash, transferred.

Mr. W. C. Whittaker has been appointed assistant master mechanic of the Rio Grande Western at Helper, Utah, vice Mr. C. E. Deweese, resigned.

Mr. J. G. Neuffer has been appointed superintendent of machinery on the Illinois Central, with headquarters at Chicago, Ill., vice Mr. Wm. Renshaw, resigned.

Mr. Henry Eisle has been appointed general foreman of shops of the Wabash Railway, with headquarters at Ft. Wayne, Ind., vice Mr. J. M. Robinson, transferred.

Mr. N. L. Smitham, formerly master mechanic of the Texas Midland, has been appointed master mechanic of the Texas Central, with headquarters at Walnut Springs, Texas.

Mr. A. C. Miller has been appointed general foreman of the mechanical department of the Texas Midland, with headquarters at Terrell, Texas, vice Mr. N. L. Smitham, resigned.

Mr. W. Cockfield has resigned as locomotive superintendent of the Mexican Railway to become chief locomotive superintendent of the Peruvian Corporation at Lima, Peru.

Mr. F. P. Huntley, vice-president and general manager of the Gould Coupler Company, has just returned from a trip of some few months abroad, where he has been on business and pleasure.

Mr. J. H. Nash, master mechanic of the Illinois Central at Paducah, Ky., has been transferred as master mechanic on the same road to Waterloo, Ia., vice Mr. R. W. Bell, promoted.

Mr. J. M. Robinson, general foreman of shops of the Wabash at Ft. Wayne, Ind., has been transferred to St. Thomas, Ont., in a similar capacity, vice Mr. W. C. Chambers, promoted.

Mr. David Newhall has been appointed manager of the department of supplies for railroads, manufacturers and contractors, of the George M. Newhall Engineering Co., Ltd., of Philadelphia, Pa.

Mr. John R. Thompson, mechanical engineer of the Fitz-Hugh Luther Company at Hammond, Ind., has been appointed mechanical engineer of the Chicago Great Western, with office at Oelwein, Ia.

Mr. Everett E. Stone, formerly engineer of maintenance of way and structures on the Boston & Albany, has been appointed chief engineer of that road, with headquarters at South Terminal Station, Boston, Mass.

Mr. R. W. Bell, formerly master mechanic of the Illinois Central at Waterloo, Ia., has been appointed assistant superintendent of machinery on that road, with office at Chicago, vice Mr. J. G. Neuffer, promoted.

Mr. Walter E. Emery, formerly engineer of maintenance of way of the Chicago & Alton, at Kansas City, Mo., has been appointed chief engineer on the Peoria & Pekin Union Railway, vice Mr. Stanley Millard, resigned.

Mr. T. C. Hudson, master mechanic on the Canadian Northern Quebec Railway, will be removed from Shawinigan Falls to Quebec, and be in charge of mechanical matters on that road and the Quebec & Lake St. John Railway.

The appointment of Mr. J. P. Mabee, heretofore a Justice of the High Court for Ontario, as Chief Commissioner of the Canadian Railway Commission, succeeding the late Mr. A. C. Killam, has been announced in the Canadian Gazette.

Mr. A. S. Burrows, formerly connected with the motive power department of the Buffalo & Susquehanna, but latterly chief clerk of that department on the Rock Island, has resigned to take a similar position with the Lackawanna at Scranton, under Mr. T. S. Lloyd, superintendent of motive power. He was associated with Mr. Lloyd on the Rock Island.

Mr. William R. Toppan, who for the past six years has been general manager of the Kenniott Water Softener Company, has resigned. Mr. Toppan has been identified with the railway supply business for the past twenty years, so he will probably be heard from again in the same field in the near future. We join with his many friends in wishing him every success.

The business interests of the H. W. Johns-Manville Co., in the City of Detroit, and the territory adjacent thereto, have increased to such an extent that a new branch is to be opened by that company. This branch will be at No. 72 Jefferson avenue, Detroit, and is under the management of Mr. Willard K. Bush. Mr. Bush is well and favorably known throughout that section of the country, having been conected with the Milwaukee branch of the company for a number of years. The company will have a complete stock of goods at the Detroit branch, so that shipments can ordinarily be made directly from that point.

Dr. Frederick H. Millener, whose interesting experiments with wireless control of machinery on the Union Pacific, are described in another column of this issue, graduated from the Jefferson Medical College, Philadelphia, in 1894, at the head of his class. Thence he went to Buffalo, N. Y., and engaged in practice. He, however, spent much time in the electrical laboratories of De Veaux College, Suspension Bridge, N. Y. The big power plants in the vicinity of Buffalo had an irresistible attraction for him. He took a course of study in De Veaux College, including all there was to be had on electricity. He also took work in Niagara University. When his ability as a physician brought him large practice he often spent the day attending his patients and then hurried to a private laboratory which he had fitted up and spent the entire night at his electrical experiments. Two years ago he gave up his practice and came to the Union Pacific shops as electrical engineer. His career has been remarkable, showing as it does a power drawing him irresistibly from the profession of medicine, which was the end toward which his youthful thoughts and energies were directed by his parents in his student days, to the fascinating field of electricity with all its marvels and its broad realm of possible discovery.

Obituary.

William J. Murphy, vice-president of the Cincinnati, New Orleans & Texas Pacific and Alabama Great Southern, died at his home in Cincinnati, Ohio, on May 10th, at the age of 60 years. Mr. Murphy was born at Greenfield, Mass., on August 23rd, 1848, and entered railway service in April, 1862, with the Erie Railway, afterward the New York, Lake Erie & Western. He remained with that road for 38 years, serving successively as messenger in the telegraph office, telegraph operator and ticket clerk at Deposit, N. Y., station agent and yardmaster, telegraph operator in the train dispatcher's office, train dispatcher Delaware division, chief train dispatcher and division operator same division, and from August, 1882, to November, 1884, he was superintendent of that division. He then became superintendent of the Buffalo and Rochester divisions, and from August, 1887, to March, 1890, he was general superintendent. In March, 1891, Mr. Murphy was appointed superintendent of the Brunswick division of the East Tennessee, Virginia & Georgia at Macon, Ga., and two years later he was made superintendent of the Cincinnati division of the Cincinnati, New Orleans & Texas Pacific. He was promoted to the position of general manager

in November, 1899, and was chosen vice-president of that road and of the Alabama Great Southern in April, 1903. Mr. Murphy was the originator of the stereopticon method of instruction in railroad signalling, which was illustrated and described in our March issue.

Leon Millard, after a comparatively brief illness, died Tuesday, May 5th, at Rutland, Mass., where he had been staying for the past four weeks. Mr. Millard was 21 years of age. His illness was of short duration, beginning about the last of February, and rapidly growing worse until the end. He was born in Attleboro, Mass., and graduated from the public schools. About four years ago he took up the study of locomotives and entered the locomotive works in Providence, R. I., as an apprentice. He showed marked progress, and after many promotions was transferred, about a year ago, to the drawing office of the American Locomotive Company at Schenectady, N. Y. He became absorbed in his work to such an extent that he found little time for anything else, with the result that his health gave way under the strain. In February, he came home to Attleboro, but the very best of loving care did not avail to save him. He had shown remarkable promise and ability in the work he had chosen for his career, and his loss is deeply deplored by all who knew him.

George S. MacKinnon, assistant master mechanic on the Canadian Northern Railway, died last month at his home in Winnipeg, Man. Mr. MacKinnon had for many years been connected with the Canadian Pacific. He was an engineer on the South-Eastern Railway many years ago, in the Province of Quebec, before that line was acquired by the C. P. R. When the South-Eastern became part of the Canadian Pacific he was master mechanic at Farnham, Que., and was subsequently moved to Toronto as master mechanic of the Ontario & Quebec division. Later he was transferred to the Winnipeg shops of the C. P. R., and a few years ago he resigned from that company's service and took a position on the Canadian Northern.

Walter G. Berg, chief engineer of the Lehigh Valley, died suddenly at his home in New York from an attack of acute indigestion. He had been engaged in railroad work since 1879, beginning his career as an inspector for the Delaware Bridge Co. He had been connected with the Lehigh Valley for more than ten years.

Mr. Berg was a member of the American Society of Civil Engineers, the American Railway Engineering and Maintenance of Way Association, of which he was only recently elected president; the American Roadmasters' and Eastern Maintenance of Way Association, American Association of Railroad Superintendents, Society for the Promotion of Engineering Education, American Society for Testing Materials, New York Railroad Club, former president of the Association of Railroad Superintendents of Bridges and Buildings, and a member of the Founders and Patriots of America. He received a gold medal in 1876 for a prize treatise on "Spherical Conic Sections," and was the author of several scientific works.

William A. Pitcher, who, for the last two years, held the position of Eastern Railroad representative of S. F. Bowser & Co., was one of the twelve who lost their lives in the burning of the Aveline Hotel, at Fort Wayne, Ind., on May 3rd. Mr. Pitcher was forty-five years old and was highly esteemed, and had many warm friends throughout the entire railroad fraternity. His loss will be deeply regretted by all his friends.

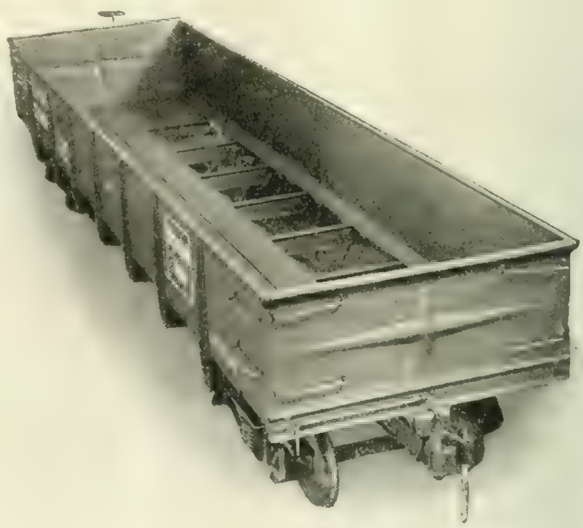
50-Ton Drop-Bottom Gondola.

The Chicago, Burlington & Quincy have recently received the last of the order for one thousand cars; they are 100,000 lbs. capacity, all steel, drop-bottom gondolas, which were built by the Bettendorf Axle Company, of Davenport, Ia. The car presents a handsome appearance, and has some interesting features which go to make up an exceedingly strong form of construction.

Car designers have, roughly speaking, followed two distinct lines of construction; one is where the load is carried upon deep, fish-bellied, centre sills, with side sheets having little carrying value; the other plan is to make the centre sills, usually channels, act as columns to absorb pulling and buffing shocks. The Bettendorf Axle Company have produced a car which happily combines these two theories. The sides and the centre sill are made to carry their respective loads, yet the carrying power of all the members is so arranged that no one part is unduly stressed or requires to be of abnormal section to give it the necessary strength.

The general dimensions of the car are 40 ft. long inside, 9 ft. 6 ins. width inside, 51 ins. depth inside. The side sheet is of ¼-in. steel, shaped at the bottom with a wide sloping flange, which does not retain any material when the car is dumped. Each side is made up of two sheets, spliced at the middle by the centre stake and a heavy splice plate. Each side sheet is stiffened by seven stakes made of pressed steel. Each stake is riveted to the end of a cross sill, for a length of 10 ins., giving firm resistance against side thrusts. Our illustrations clearly show the coping roll and other details which make the entire side present a neat and compact appearance.

The end sheet is made with a deep, heavy, top roll, and flanged at the corners to make a connection for the side



STEEL GONDOLA ON THE "Q," BUILT BY THE BETTENDORF CO.

The car is of quite an open type, which renders inspection easy. Most of the members are made of standard rolled sections, easy to obtain and easy to apply. The side and end sheet construction are radical departures from the generally accepted form. Instead of the ordinary top chord angles, the side coping is formed by rolling the sheet at the top into a long tube, 2¼ ins. inside diameter. The end sheet has a heavier top roll and is additionally stiffened by a heavy corrugation.

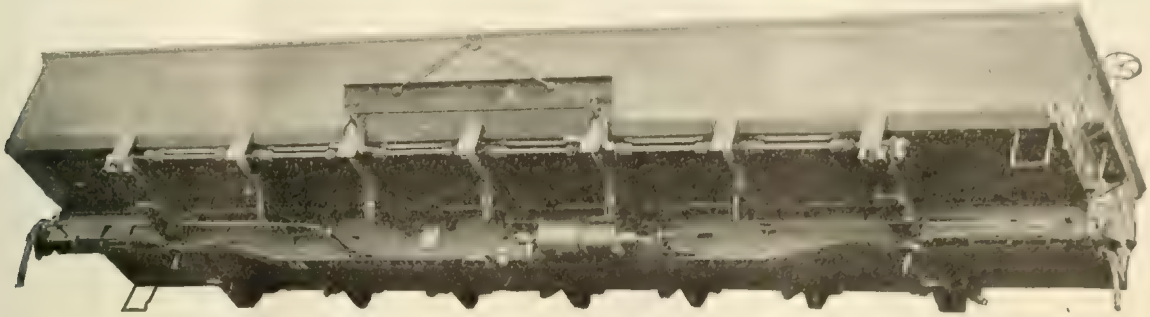
sheets. It is further stiffened by a large star-shaped corrugation, 3 ins. deep. The sheet is made of ¼-in. steel and is shaped cold. The end sill is riveted to the sheet and is made of a 10 in. channel, the top flange of which is bent upward to lie flush against the end sheet, and the web is shaped into a long, straight corrugation across the car. Poling pockets are also pressed into the channel web. The end sill is shaped in one operation with the metal cold. The severity of treatment

given to it ensures only the best grade of open hearth steel being used.

The characteristic feature of this car is the single centre sill which is designed, should concentrated weights be hauled, to carry the entire load, or when the car is loaded uniformly, to carry only 58 per cent. of it. The centre sill is made up of three distinct members; a 24 in., 80-lb. I-beam; an 18-in. cover plate; and the Bettendorf cast steel centre sill ends or centre sill. Permanent floor plates of 5/16 ins. steel extend from the body bolster to the end sill, and are riveted to the side sheets with the centre sill compression plate hiding the joint of the plates.

Five 10-in. I-beams and two Bettendorf body bolsters constitute the cross sills. In many cars heavy transoms and light floor-beams are used. In this design of car, however, each needle beam has been made strong enough to transmit flange of side sheets.

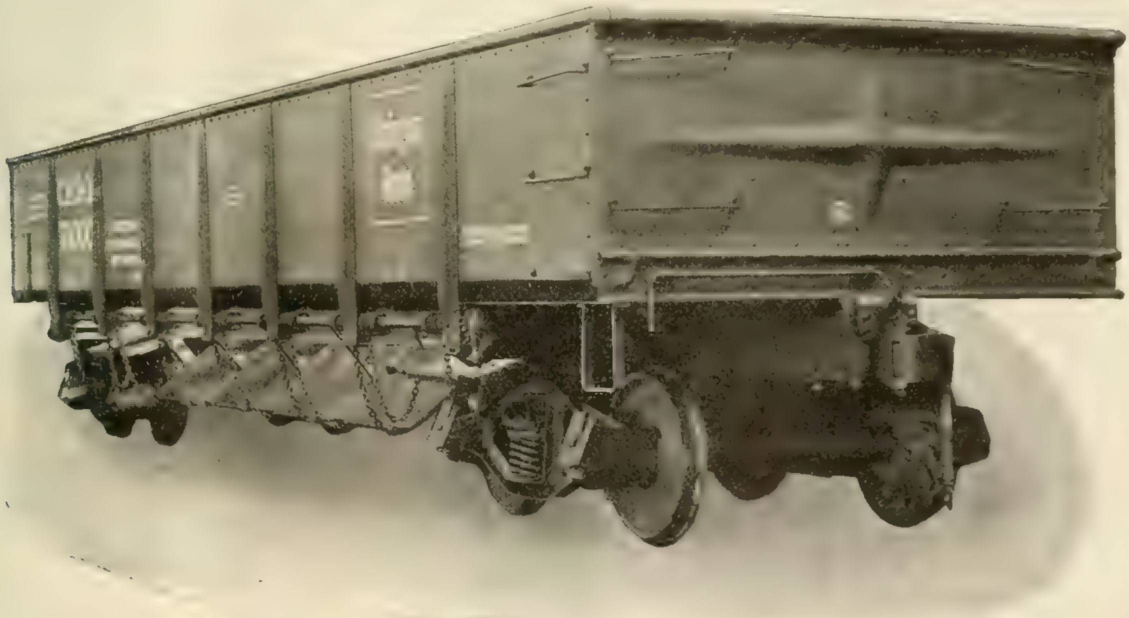
The trucks are the Bettendorf standard cast steel side frame 50-ton type. The truck has the journal boxes cast integral with the side frames, and dispenses with arch bars, columns, bolts, etc. The cast steel side frame reduces the weight of the trucks about 1,000 lbs. per car and eliminates nearly 200 pieces per set of trucks. The light weight of the car is 37,800 lbs. and trucks alone 14,260 lbs. The tare



UNDERSIDE OF THE C. B. & Q. CAR, SHOWING CENTRE SILL.

draft sills. The I-beam centre sill extends between the bolsters, and the web is cut out at each end and the bottom flange thrown up, reducing the beam's depth at ends from 24 ins. to 15 3/16 ins. The Bettendorf centre sill ends are cast steel with draft lugs cast integral and are arranged for tandem draft gear, but they can be readily designed to accommodate any desired draft gear. The centre sill ends extend from the striking its load to the centre sill, and because of the beam being continuous from side to side of the car, it does not depend upon rivets to properly perform its duty. The top flange of the I-beam is set down at the centre, which allows the top of the needle-beam to come flush with the floor level without making a cut in the top flange of the centre sill.

The load is dumped by means of 12 drop doors, operated by winding chains weight runs about 2 to 3,000 lbs. lighter than the ordinary car of like dimensions. The openness and simplicity of the car permit inspection to be quickly and easily accomplished. The fact that there are but a few hot pressed shapes in the whole car facilitates repairs at small divisional points, and as the various members have not their coating of iron oxide destroyed by reheating, it helps them to resist the corrosive action of coal or moisture. The

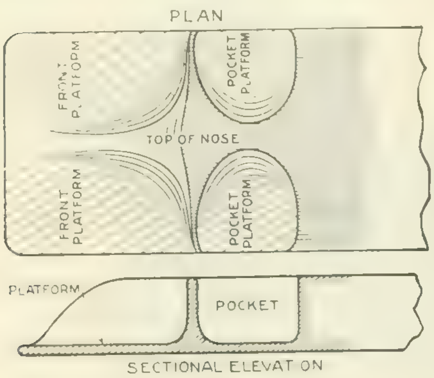


50-TON STEEL GONDOLA FOR THE CHICAGO, BURLINGTON & QUINCY.

plate to back of the body bolsters, where they are riveted to the centre sill I-beam, with heavy rivets. The body bolster is continuous and passes through the centre sill ends and is securely riveted to them, both top and bottom. The cover plate runs the entire length of the car. The drop door hinge butts are riveted to the cover plate and web of the I-beam and a shaft 2¼-in. in diameter. The doors are made of 5/16 in. steel, flanged and secured to the centre sills by malleable iron hinges. Steel hangers riveted to the needle-beams catch the doors and take away all strain from the winding chains when the load is dumped. The dumping mechanism is a creeping shaft device and is protected from injury by the bottom construction of the centre sill gives it power to resist high buffing shocks and the principle of distribution of stresses enable the car to withstand the heaviest kind of service. A car of this design will be exhibited on the show tracks at the M. C. B. and M. M. Conventions at Atlantic City, and visitors will be amply repaid by a careful inspection of the car.

The Strouse Stoker.

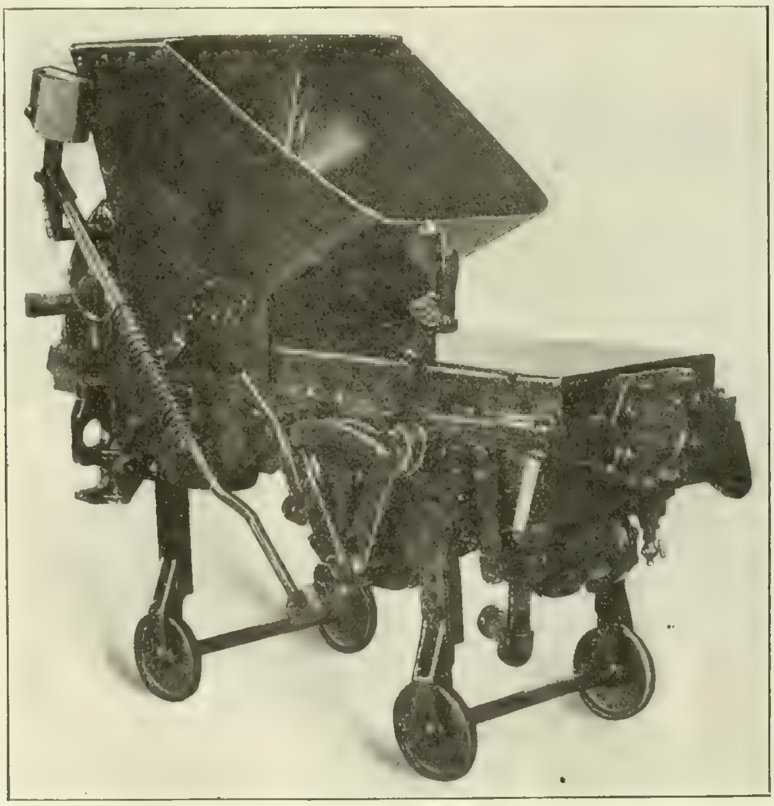
This stoker is of the plunger type, and although it was not evolved from what was formerly known as the Day-Kincaid stoker, its general appearance is somewhat similar. It consists of a detachable frame mounted on wheels for easy handling. This frame carries a detachable hopper, the reciprocating plunger which distributes the coal, and a horizontal steam cylinder with valves, valve motion, throttle lever, etc. There is a special fire door hinged at the top which opens inwardly and is operated automatically. A simple conveyor, not shown in the illustrations, takes coal from the bottom of the tender and delivers it to the hopper.



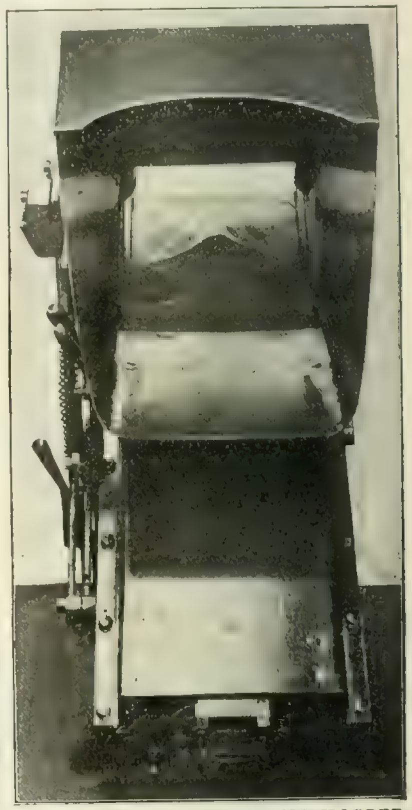
PLAN AND SECTION OF NOSE.

The delivery and distribution of coal is effected by the action of a steam-driven plunger moving horizontally and mounted in guides. This plunger is fitted with a specially shaped steel nose, as shown by the photograph taken from above at an angle of 45 degs. Coal from the hopper feeds down into the pockets and upon the plunger nose platform in the firebox doorway. The forward movement of the plunger scatters the coal forward and to the sides, so that the forward part and front corners of the grates and the front corners of the firebox are properly covered. The body of the plunger when pushed forward cuts off the coal feeding from the hopper until the nose returns to its farthest back position to receive the next charge. Two pockets are provided, one on either side of the rear portion of the nose, and these carry a part of the coal into the firebox on the forward stroke of the plunger, and on its return stroke these pockets discharge this coal into the back corner and rear part of the grates.

The specially designed firedoor is hinged at the top and is opened and closed automatically by the operation of the stoker throttle mechanism. The whole apparatus with the exception of this door is secured to the fire door ring by two slotted lugs and keys and by suspension turn-buckle rods which hook into eyes on the boiler head. The stoker is thus easily detachable and can be quickly removed for hand firing in case of breakage. The hopper is so arranged that it can be used to fire alternate sides of the firebox, if desired.


THE STROUSE AUTOMATIC STOKER.

The operation of the stoker by the fireman consists in regulating the speed of the conveyor mechanism and governing the length and intensity of the plunger stroke by the stoker throttle lever. The movement of the plunger is not automatically reduced to a cycle, as with other forms of mechanical stokers. The plunger stroke can be shortened or lengthened at will by the fireman, who can also vary the speed with which it moves. After having set it to work the plunger movement remains constant until altered by the fireman. Heavy consolidation locomotives on the Iowa Central are being successfully fired by this stoker, which is made by the Locomotive Stoker Company of Chicago.


TOP VIEW OF PLUNGER AND HOPPER.

The Bettendorf Axle Company, of Davenport, Ia., have moved their Chicago office from 1590 Old Colony Building to 1170 Old Colony Building in the same city, and the same company have moved their New York office from 42 Broadway to the Hudson Terminal Building, 30 Church street, New York.

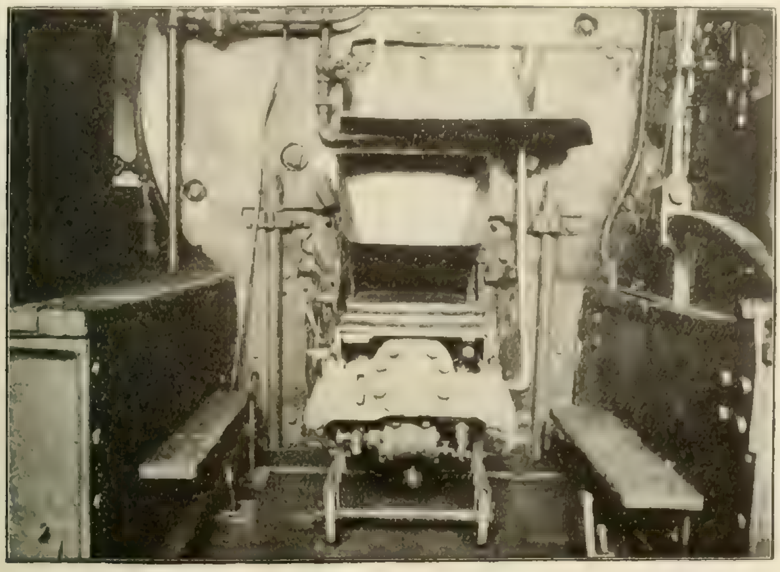
The well-known firm of Jerome & Elliott, licensees Jerome Metallic Packing, have moved to Nos. 351 and 353 West Monroe street, New York. These are larger and better quarters, thus giving the firm increased facilities for manufacturing This is the first move of the kind that Jerome & Elliott have made in twenty years and it shows their confidence in the ultimate increase of business.

Hammer and Chisel.

In spite of the fact that the air hammer is coming rapidly into general use, it is not at all likely that the use of the old-fashioned hammer and chisel will ever become a lost art. A good chipper is a sure sign of an accomplished machinist. A mastery of the art does not come to any one over night. It can only be acquired by steady practice, and is generally accompanied by wounds and bruises. The hand holding the chisel usually suffers most. A machinist, like Othello, could beguile us of our tears recounting the distressful strokes from which his youth suffered. The evil is frequently augmented by poor tools. Hammers unshapely and ill balanced, chisels of poor steel, poorly dressed and ill tempered and improperly ground form a combination that jar the delicate sensibilities of the unhappy apprentice, and each re-percussion piles on the agony, like Pelion on Ossa, until the weary nerves almost cry aloud in anguish.

Shop-made, or home-made, hammers are almost always unfit for use, unless it might be for cracking hickory nuts. Factory-made hammers, where the mechanical appliances used are perfect in form and structure, and the steel selected is based on reliable tests, are the proper tools to use. Apart from the form and weight of the hammer, the handle is of vital importance. It should be slightly flexible and should be so set in the eye of the hammer that its length should not only be at right angles to the axis of the hammer head, but its longest cross section as described in the oval form of the handle should be perfectly parallel with the axis of the hammer head.

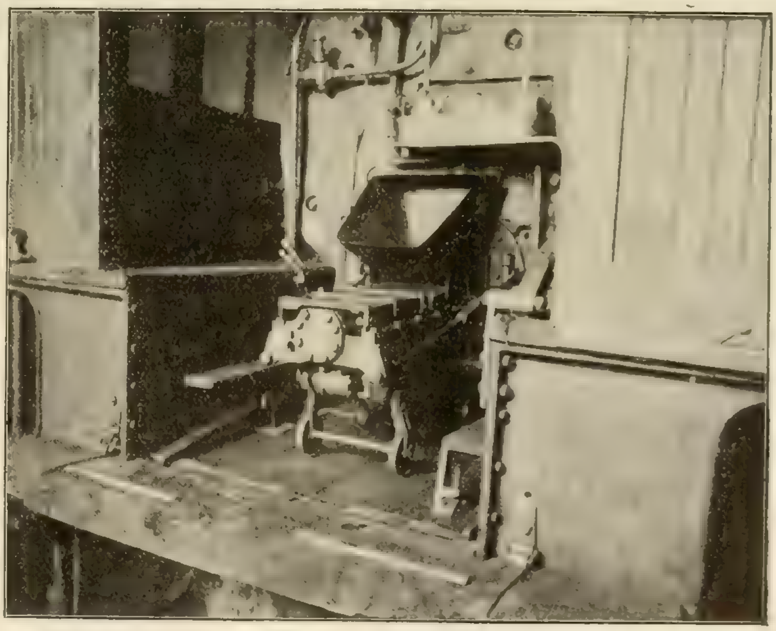
The best chisels are octagon steel, about seven-eighths of an inch in thickness and seven or eight inches in length. The flat faces of the chisel should be on a perfect plane with one of the sides of the octagon, and the dressed portion between two and three inches from the cutting edge of the chisel. Experience speedily determines the degree of thinness and also the angle of the cutting edge. Steel will require the shortest angle, being the hardest material; sixty degrees being about the reliable limit. Softer metals can be readily cut with chisels ground at longer angles. The cutting face of all chisels used on metal cutting should be slightly rounded, increasing in curve towards the corners. It will be noted that the tendency of the chisels to dig in at the corners is very great and forms an important blemish, involving much subsequent work in removing the marks from surfaces requiring to be perfectly smooth.



BACK VIEW OF STROUSE STOKER

In chipping, care should be taken to direct the eye on the cutting edge of the chisel. Directing the attention to the head of the chisel cannot fail to lead to disaster. As we stated at the outset, however, nothing can take the place of a trying experience, and it is only after long, laborious efforts that the hand and eye and hammer and chisel work in perfect unison, and the rhythmic cadence of successive blows always marks the master machinist, the sculptor in metal.

There is a very old expression in common use and that is "right as a trivet." Some people paraphrase it by saying, "tight as a rivet," but this is wrong, as the original expression is the first one. The "rightness" of the "trivet" depends upon the fact that the trivet is what its name implies, a three-legged stand; and a three-legged stool will stand firm on any sort of rough ground, hence the significance of the expression, and this leads us to remark that one of the points of excellence of the Johnson Frog is the fact that it is practically a trivet, and when in place, ready for business, it is supported on three points and this insures a solid bearing on any kind of track. It will, on account of this triangular shape, replace at one setting wheels off on either side of the rail. There are ten points of excellence enumerated by the Johnson Wrecking Frog Company, of Cleveland, Ohio, in a neat little illustrated booklet which they have recently sent us. Their re-railers are substantial, handy, useful things. Write them for the booklet and get the other eight points. We have given two here.



STROUSE STOKER IN POSITION ON AN ENGINE.

Mikado For the Kentucky & Tennessee.

The Baldwin Locomotive Works have recently completed for the Kentucky & Tennessee Railway, a Mikado, or 2-8-2, type of locomotive which possesses a number of interesting features. This engine is intended for comparatively short hauls on a line having grades of 4 per cent. which occur in combination with curves of 20 deg., and not compensated. In order to enable the locomotive to easily enter sharp curves when running in either direction, the 2-8-2 wheel arrangement is employed. The piston stroke is comparatively short, and by using driving wheels of 44 ins. diameter, a tractive force of 40,900 lbs. is developed, while the rigid wheel base is only 11 ft. 6 ins.

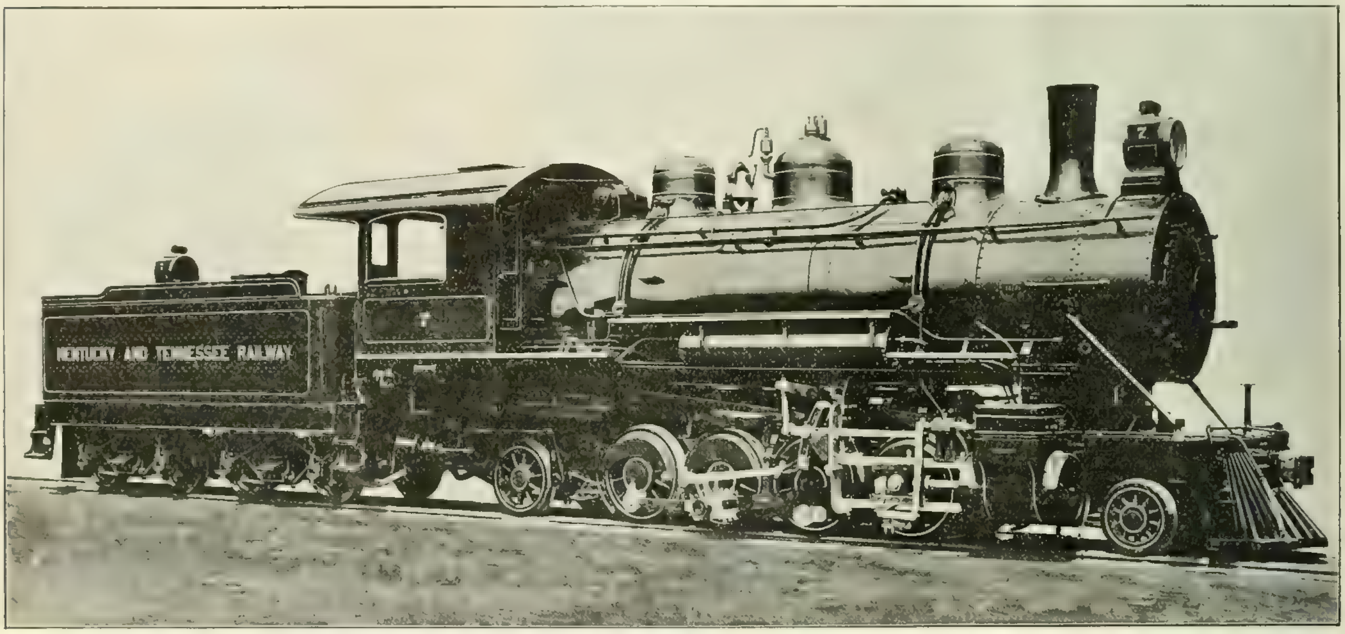
The leading truck is of the usual swing bolster design, with radius bar, and is equalized with the first and second pairs of driving wheels. The two remaining pairs are equalized with the rear truck, which is of the Rushton type, with inside journals. A half elliptic spring, having arms of unequal lengths, is used in the equalization system, between the rear driving wheels and the back truck.

The main frames are of cast steel, with rear sections of the same material, and double front rails of wrought iron. The splice between the main and rear sections is back of the rear driving wheels, at which point the frame is supported by the spring previously mentioned. The pedestal binders are lugged and bolted to the pedestals.

The cylinders are single expansion, 21 x 24 ins., equipped with balanced slide valves, which are actuated by the Walschaerts valve gear. The link is of the built-up type, and is supported by a cast steel bearing which is bolted to the back of the guide yoke. The valve rod is supported by a bracket which is bolted to the top guide bar. There is sufficient room in this design to place the combining lever in front of the crosshead, and thus use a short valve rod, which is substantially supported, adding to the rigidity of the motion. The reverse shaft is placed in bearings which are bolted to the guide yoke. The radius rod is extended back of the link, and is suspended at the rear end. The valves have an outside lap of 1 in. and no inside lap. They are set with a maximum travel of 5½ ins., and a constant lead of 3-16 in. The guide yoke is made in three pieces, the lower extension on each side being securely bolted to the main section. This feature adds to the convenience in handling these parts. The crossheads are of the "alligator" form and have cast steel bodies and bronze gibs.

The boiler is of the straight top, radial stay type, with wide firebox having a vertical throat sheet and back head. The mud ring is supported on sliding shoes in front and a buckle plate at the rear. The front end of the crown is supported by one ⊥-bar, and 330 flexible stay bolts are placed in the breakage zone in the throat, sides and back sheets. The boiler barrel is built with three rings, 72 ins. diameter at the front and the dome is centrally located. The longitudinal seams are welded at the ends, except on the dome ring, where the seam is placed on the top centre line and is welded throughout its length on either side of the dome opening, the seam is re-enforced by a heavy inside liner. The heating surface in this boiler is 148 sq. ft. in the firebox, 2,529 in the tubes, making a total of 2,677 sq. ft. There are 315 tubes, 2 ins. in diameter and 15 ft. 5 ins. long. The grate contains 41.2 sq. ft., making the heating surface about 64 times the grate area.

The tender is carried on arch bar trucks, which are equipped with cast steel bolsters and chilled cast iron wheels. The tender frame is built of steel channels. A pilot is provided at the rear end. The tank capacity is 5,000 gallons and 6 tons of fuel are carried. This locomotive, although not intended for long hauls in main line service, is an interesting example of a design built to operate under difficult conditions. The 2-8-2 wheel arrangement is particularly suitable for roads having light rails and many curves, while it allows the use of a larger boiler than could be applied to a consolidation type locomotive with the same weight on driving wheels. Some of the leading dimensions are as follows:



HEAVY 2-8-2 SIMPLE ENGINE FOR THE KENTUCKY & TENNESSEE RAILWAY.

O. G. Petersen, Master Mechanic. Baldwin Loco Works, Builders.

Boiler—Type, straight; material, steel; thickness of sheets, ¾ in.: working pressure, 200 lbs.; fuel, soft coal; staying, radial.

Firebox—Material, steel; length, 90 ins.; width, 66 ins.; depth, front, 66½ ins.; depth, back, 59 ins.; thickness of sheets, sides, ⅜ in.; back, ⅜ in.; crown, ⅜ in.; tube, ½ in.;

Water Space—Front, 4 ins.; sides, 3½ ins.; back, 3½ ins.

Tubes—Material, iron; wire gauge, No. 11.

Driving Wheels—Diameter, outside, 44 ins.; journals, 8½ x 10 ins.

Engine Truck Wheels—Diameter, front, 28 ins.; journals, 5½ x 10 ins.; diameter, back, 36 ins.; journals, 6 x 10 ins.

Wheel Base—Driving, 11 ft. 6 ins.; total engine, 25 ft. 5 ins.; total engine and tender, 51 ft. 10 ins.

Weight—On driving wheels, 140,050 lbs.; on truck, front, 16,350 lbs.; on truck, back, 24,000 lbs.—total engine, 180,400 lbs.; total engine and tender, about 280,000 lbs.

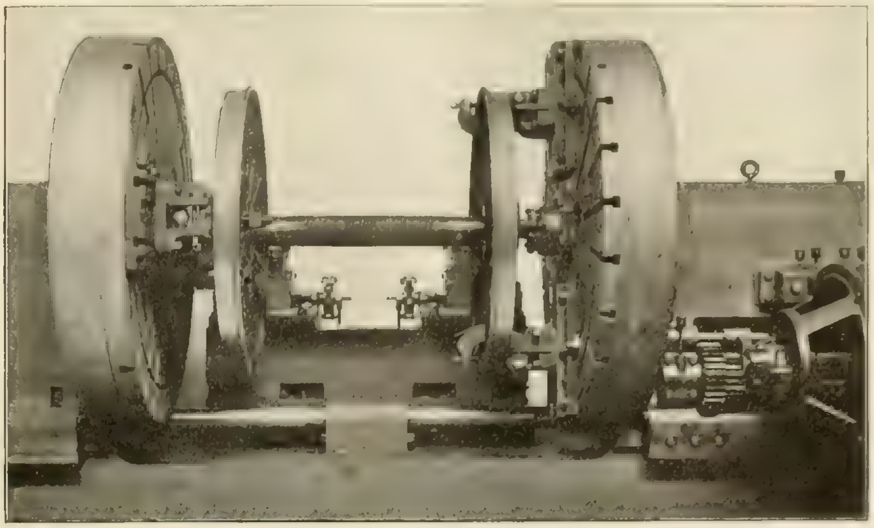
Tender wheels, diameter, 33 ins.; the journals are 5 x 9 ins.

High Power Wheel Lathe.

The introduction of high-speed steel has rendered possible a substantial increase in the cutting capacity of wheel lathes, and has led to the development of machines capable of very considerably increased output. Our illustrations show one of this kind of lathe designed for turning locomotive driving tires, which has lately been put upon the market by William Sellers & Company, Inc., of Philadelphia.

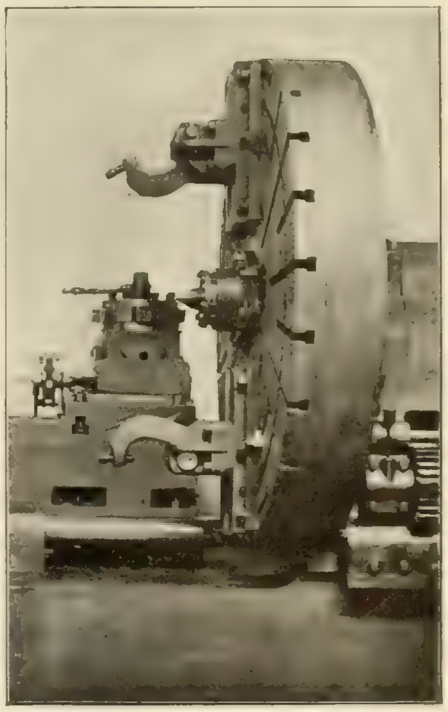
It may be said that the actual cutting time per wheel in these machines has been reduced to such a point that the time lost in handling and setting the work and changing the tools has become relatively more important, and improvements intended to reduce the time and the labor of performing these operations have been made, and a design of wheel lathe having the necessary power and stiffness to take the heaviest practicable cuts, has been produced, with additional features which facilitate the handling of the work and the tools.

One of the interesting points of this lathe is the driving mechanism. It consists in each case of a floating block bolted to the faceplate. This block has in it a gripping jaw against which the outer edge of the tire is pressed. From the block, and passing over the rim between the spokes, is a clamping arm. This is pivoted to the floating arm and at its outer end contains a set-screw which, when tightened up firmly, secures the whole in position. The clamping arm is provided with a latch which holds it up clear of the wheel rim when a pair of wheels are being placed. When the face plate is revolved, this driver will automatically open and latch. The side motion in the clamp is utilized as a toggle, resulting in a driving power proportional to the resistance of the cut. The wheel is here shown clamped by one of the drivers. When the wheel is revolved and the tool begins to act, the grip of the drivers becomes firmer; increasing with the pressure on the tool. The wheel is released by simply loosening the set screw while the lathe is slowly running. The driving arm drops open and latches in that position. There are no loose pieces to be handled. These drivers may be manipulated with great rapidity.



LARGE SELLERS WHEEL LATHE, MOTOR DRIVEN.

The object of this arrangement was to make a form of driver which would securely lock the wheels against the pressure of the heaviest cuts without side strain in the wheel rims, one that would hold with a resistance proportional to the cut and one that would also be self-contained, without loose parts to be removed or replaced in changing wheels. The drivers grasp the inner and outer faces of the tire without straining it sidewise. They may be each clamped by

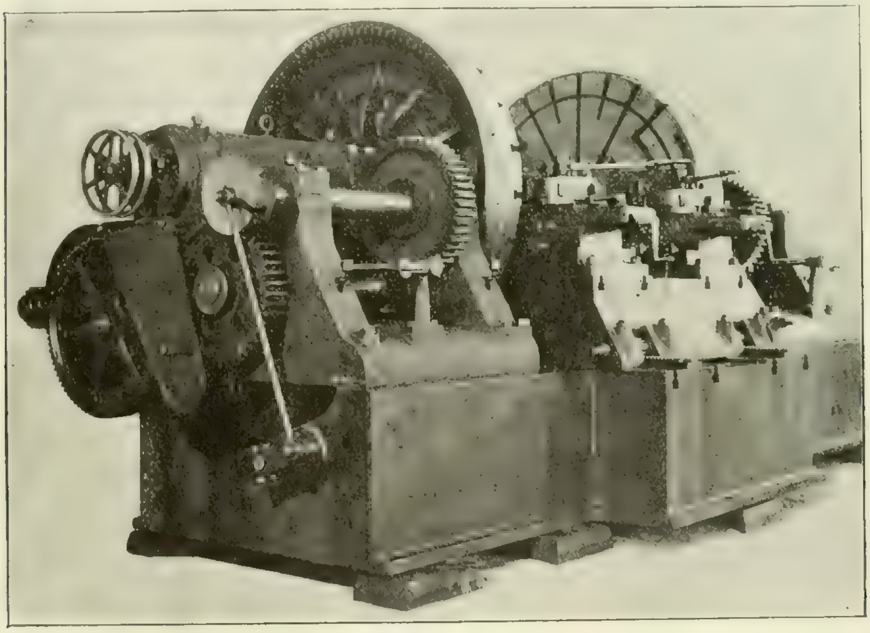


THE GRIP AND DRIVING MECHANISM.

one set screw with an ordinary short wrench, and they automatically tighten as the cut is increased. Each driver is mounted in a swing frame or plate secured to the face plate of the lathe, for conveniently adjusting the driver to suit diameters of wheels, location of crank pins, and number of spokes.

The two turret tool holders are arranged for the set of tools required for roughing and finishing the rims. They are of special construction, so that each tool can be brought into position in its turn by simply rotating the turret by hand lever. When the various working positions of the turret are reached, a spring latch holds it securely, while a further motion of the hand lever clamps the turret firmly. The turret is of steel, and the center clamping bolt has a transverse opening for the roughing tool; thus permitting a long bar to be used, capable of frequent redressing. The forming tools horizontal plane as the tools, and on the same side of the center. The tool loads are thus transmitted directly through the face plate and drivers without imposing any pressure upon the spindle bearings. The front of the openings in the turrets, for the forming tools, is made with a slight taper, to fit which a corresponding taper is provided on the tool sockets. The tools are thus accurately centered and securely held against side motion. This also permits a reduction in the size of the tool body without decreasing the broad bearing surface which supports the tool near the cutting edge.

The power is transmitted to the face plates from the long driving shaft through two reductions of gearing, and not directly from the shaft itself. This arrangement, in connection with the large diameter of the shaft, produces a drive which is free from all tendency to chatter. The spindle caps on the heads are



VIEW OF LATHE SHOWING TURRET TOOL HOLDERS AND BENCH.

are not subject to frequent renewals, and may be conveniently made with short shanks. The turrets are mounted on slide rests which are very heavy and low, carried on a bench adjustable by racks and pinions to suit the diameters of wheels. The base of the slide rest is arranged to swivel on the bench to suit the angle of the wheel tread. The slides are each provided with a feed ratchet, the connections for which are fitted with ball joints. A convenient micrometer screw and stop on the side of the cross slide enables the wheels to be rough turned to the same diameter without calipering. The stop can be swung aside while finishing.

The lathe is thoroughly well built in every respect. It is exceedingly massive and of great weight. The bed is broad and of unusual depth, forming a very rigd base. The pinions for driving the face plates are placed in nearly the same made in one continuous piece, producing a nearly solid support for the hardened steel step which is placed at the end of the spindle for taking end thrusts. Secured to the face plates are flanged bearings through which the sliding spindles pass, reducing their overhang when supporting the work. These bearings are supplied with split taper bushings for taking up wear, maintaining an easy fit without lost motion, which would produce chatter. When desired, these bushings may be closed tightly upon the spindle, thus forming an additional clamp. For driving the lathe a motor of ample size is provided, which has a speed range of 2 to 1, which, together with the mechanical changes, gives spindle speeds varying from ⅜ to 1½ turns per minute with numerous intermediate steps. Correspondence addressed to the makers asking for any additional information with

regard to these lathes will meet with a ready response.

The order recently received by the American Locomotive Company from the New York Central Lines consists of 20 engines, 22 x 28", Pacific type passenger locomotives, for N. Y. C. & H. R. R. R.; 45 engines, 23 x 32", Consolidation freight locomotives, for N. Y. C. & H. R. R. R.; 29 engines 21 x 28", six-wheel switching locomotives, for N. Y. C. & H. R. R. R.; 12 engines, 22 x 28", Pacific type passenger locomotives, for B. & A. Division; 20 engines, 23 x 32", Consolidation freight locomotives, for B. & A. Division; 10 engines, 21 x 28", six-wheel switching locomotives, for B. & A. Division.

Good Quality.

One of the sayings of George Washington which has as much force now as when he spoke the words, is "Associate yourself with men of good quality if you value your reputation, for it is better to be alone than in bad company." One application of these words which we consider fair and proper is that in a sense the kind of association with those of "good quality" can be had through books and periodicals. Books devoted to special subjects are written with a definite end in view, and in those we recommend, the good quality is among the things which are assured.

To the diligent, studious railroad man nothing can give a better general knowledge of his calling than the regular perusal of the pages of Railway and Locomotive Engineering, together with a close study of our standard railroad engineering publications, among which are the following:

"Development of the Locomotive Engine," by Angus Sinclair. A history of the growth of the locomotive from its most elementary form, showing the gradual steps made toward the developed engine, with biographical sketches of the eminent engineers and inventors who nursed it on its way to the perfected machine of to-day. Many particulars are also given concerning railroad development. It contains 680 pages and is profusely illustrated. It is bound in half morocco. Safety devices, especially the Air Brake and Safety Valve, are treated in a clear and comprehensive manner. In short it may be said that beginning with the earliest attempts at harnessing steam, the narrative unfolds itself with the interesting grace of a romance. The entrancing story is epical in the greatness of events. Price $5.00.

"Railroad Men's Catechism." By Angus Sinclair. This is a book which gives information that will be useful and acceptable to all classes of railroad men from the president to the newest brakeman. All will find in it something new and useful. All will find it worthy of study. The questions are intended to impart information covering the entire practice of train operating, and to explain all details of mechanism. The questions and answers are the outcome of Sinclair's "Locomotive Engine Running and Management," and are an enlarged code that grew up through many small forms, the best known having been the Questions and Answers prepared by the Traveling Engineers' Association. The catechism has 260 pages; it is fully illustrated; bound in ornamental cloth. Price one dollar.

"Twentieth Century Locomotives," Angus Sinclair Co., deals comprehensively with the design, construction, repairing and operating of locomotives

MODERN ELECTRIC RAILWAY MOTOR CAR.

and railway machinery. First principles are explained. Steam and motive power is dealt with; workshop operations described, valve motion, care and management of locomotive boilers, operating locomotives, road repairs to engines, blows, pounds in simple and compound engines; how to calculate power, train resistance, resistances on grades, etc. Shop tools are illustrated and explained. There are shop recipes, definitions of technical terms, tables, etc. Descriptions and dimensions of the various types of standard locomotives. The book is well and clearly illustrated and is thoroughly up to date in all particulars, fully indexed. Price, $3.00.

"Locomotive Engine Running and Management," by Angus Sinclair, is an old and universal favorite. A well-known general manager remarked in a meeting of railroad men, "I attribute much of my success in life to the inspiration of that book. It was my pocket companion for years." Latest edition, price, $2.00.

"Firing Locomotives," by Angus Sinclair. Treats in an easy way the principles of combustion. While the book deals with the chemistry of heat and combustion very fully it is easily understood by every intelligent fireman. The price is 50 cents.

The Gold Car Heating and Lighting Company of New York have issued several very useful catalogues, among which may be mentioned the one on Gold's Improved Gravity Relief Trap. The trap is intended to prevent accidents to trainmen when uncoupling steam hose between cars. It indicates the presence of steam in the train line. Another catalogue covers Gold's improved system of acetylene car lighting, and is well illustrated. The letter press fully describes the system. Gold's improved temperature regulator and stop valve pamphlet is a supplement to their 1905 catalogue. It brings the subject of temperature regulation up to date and the latest devices made by this company are clearly illustrated and described. Any or all of these catalogues may be had on application to the Gold Company, Whitehall building, New York.

Wrong Repairs.

One of the recommendations made by the Canadian Railway Club for the alteration of the M. C. B. rules of car interchange is that where cars are running on other than M. C. B. journals, the application of an M. C. B. standard axle shall not be considered wrong repairs, and that owners be charged for all excess in time for such repairs. The reason given for this recommendation is stated to be because cars are now being built and marked 100,000 lbs. capacity, with 5¼x9 in. journals, which is not an M. C. B. standard and as the rules now stand it is impossible to apply an M. C. B. axle without making wrong repairs. The club also recommends that all cars running on other than M. C. B. axles be so stenciled on body and trucks. A further recommendation is that all journal bearings which are filled, or have malleable backs, be condemned and no allowance be made for scrap.

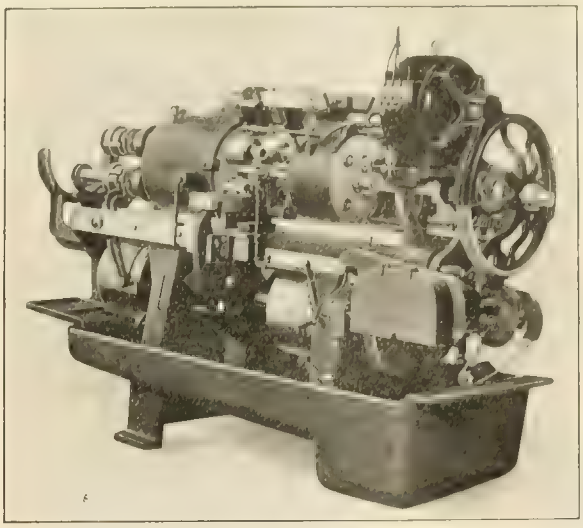
The Austin Packing and Supply Company has recently been organized under the laws of the State of New York by Mr. H. W. Austin, who has been New York manager of the American Steam Packing Company for the past twelve years. Mr. George I. Mandeville, with the same company for the last six years, is also associated with the new enterprise, and Mr. H. H. Hanson is also a member of the newly formed company. The Austin Company have taken over the local business of the American Steam Packing Company and it is expected that much new business will be secured. The Austin Company will extend their business into other fields, though they remain the agents for the American Steam Packing Company and have become the New York agents for E. F. Houghton & Co., of Philadelphia, manufacturers of greases, oils, leather packings and the Marck steam trap. The Austin Co. are also the agents for the Durabla sheet steam packing for superheated steam, which has been adopted by the General Electric Company on their turbine engines and which has also been used in the new Singer building in this city. The office of the Austin Packing and Supply Company is at 109 Liberty street, New York.

Multiple Spindle Screw Machine.

The National-Acme Manufacturing Co., of Cleveland, Ohio, will put on exhibit and demonstrate at the Railway Master Mechanics' and Master Car Builders' Convention at Atlantic City, June 17th to 24th, their No. 56 "Acme Automatic" Multiple Spindle Screw Machine, equipped with Motor Drive. Recent improvements in this size of machine provide for single belt drive, which is readily converted into a motor drive by substituting gear "G" for pulley, and placing the platform and motor on the machine as shown in our illustration of this part of the mechanism.

The advantage afforded by the single belt drive and the related changes, as claimed by the makers, are: That they make the relation between the cam shaft and the spindle driving shaft always positive, reducing the chance of accidents to the tools due to belt slippage. Belting and the resultant troubles are reduced to a

minimum on the single belt drive and are entirely eliminated on the motor drive, and the countershaft is simplified or eliminated. The output of the machine is in-



MULTIPLE SPINDLE SCREW MACHINE.

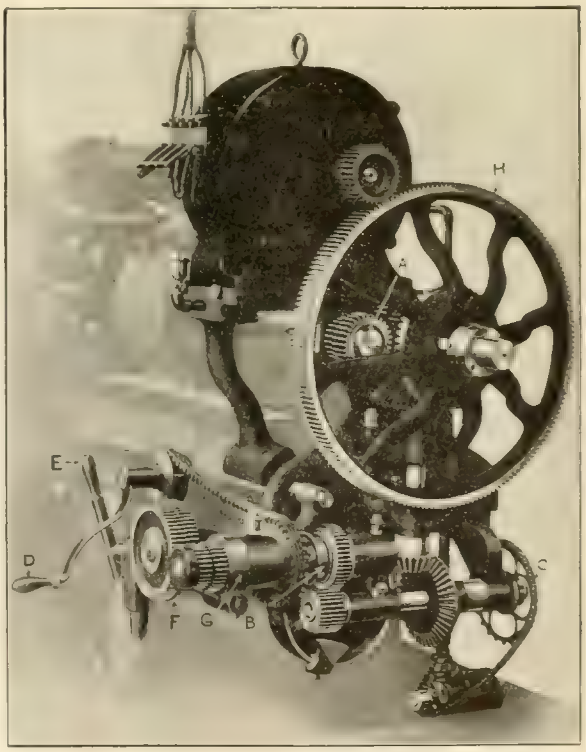
creased because the positive control of the change of speed for the tools allows the maximum use of the fast speed. In case of accident, or when stoppage for any cause is necessary, lever "E," in the illustration, provides for immediate release of the cam shaft mechanism. It is possible to move the tools intermittently when setting up or testing by use of lever "E" which throws in clutch "B." Cranking by hand is a much lighter operation, due to the fact that the transmission mechanism is cut loose entirely by means of free wheel "G." The time necessary for changing the speed of the cam shaft is considerably lessened because of the convenient location of change gears "F." The oil pump is driven at a constant speed, and the control of hand and power movements of the cam shaft mechanism as well as the flow of oil is brought within easy reach of the operator while in a position to observe the action of the tools.

The system of gearing shown is so designed that it is practically noiseless. These changes in the mechanism of the machine make the work of operating it much lighter than formerly. Visitors at the conventions will be interested by an examination of this tool. The company is in a position to supply this No. 56, $2\frac{1}{4}$ in. machine equipped for single belt drive or for motor drive, with or without motor. Any standard motor car may be used without alteration. The size of the motor required is from 3 to 5 h. p., depending upon the class on which the machine is used.

I. B. of R. E.

A recent press dispatch from Boston, Mass., states that 8,000 union railway men in the United States and Canada were represented by 120 delegates at the opening of the fourth biennial convention of the International Brotherhood of Railway employees held in Boston. President Robert P. Neil, of Boston, in his report, said that the organization is to-day in the best condition in its history. He stated that the Canadian Government railways had agreed to recognize the union, and that 2,000 employees of the Intercolonial Railway had joined the organization.

The Brotherhood of Locomotive Engineers have voted to admit to membership the engineers of all electrically driven trains on steam railroads.



DRIVING MOTOR AND GEARS.

The American Locomotive Company, of New York, have moved their general offices in this city from 111 Broadway to the Hudson Terminal Building, 30 Church street, New York.

Heavy Car Shop Machinery.

The following are brief descriptions of three wood-working tools manufactured by a well-known Cincinnati firm, who claim special merit for them in connection with car manufacturing.

Fig. 1 illustrates a Car Gainer, with an automatic traveling carriage for heavy timbers. The machine has a capacity for timbers up to 20 ins. thick and 24 ins. wide, and with a head 16 ins. in diameter, cuts gains up to 5 ins. deep. It is known as the No. 150 Automatic Car Gaining Machine.

Fig. 2 shows a heavy car mortising machine, the No. 214 Vertical Hollow Chisel Mortiser. This machine is provided with auxiliary boring attachments which can be moved through an angle 30 degs. in either direction. It is made with either

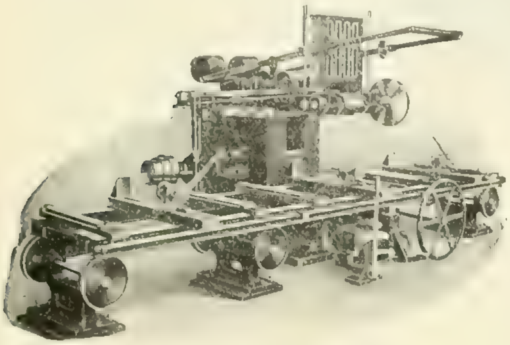


FIG. 1. CAR GAINER.

plain table, or with traveling carriage like that illustrated in Fig. 1. It has capacity for motorises up to 3 ins. square and 6 ins. deep, or by re-reversing timbers up to 12 ins. deep. Sometimes these two machines are used as one with the single traveling table between them. This facilitates the handling of heavy timbers which have to be both mortised and gained.

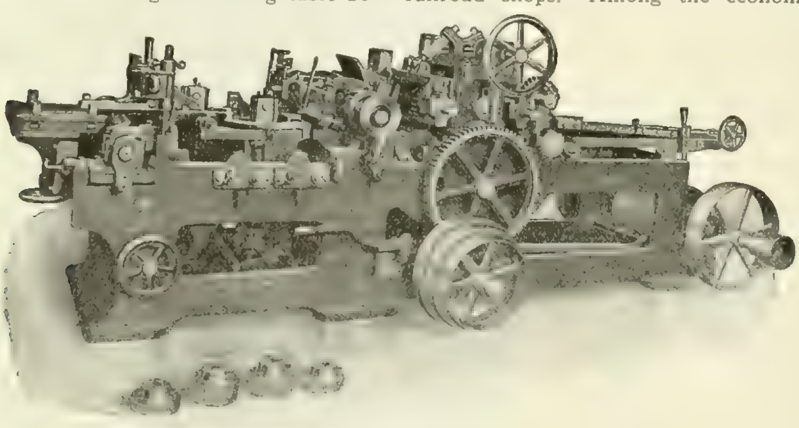


FIG. 3. INSIDE MOLDER.

Fig. 3 illustrates an Inside Molder, which does work of fine interior finish, such as is used in car construction. It is equally useful as a planer and matcher. It has capacity for material 12 ins. or 15 ins. wide and up to 6 ins. thick. Further information may be had by addressing the J. A. Fay & Egan Co., Cincinnati, O.

Hosen and Hose.

Hose is a comparatively modern word, hosen is the older form and they (for the word is plural) were the garments for the lower limbs of men before trousers came into fashion. The old-time hos-

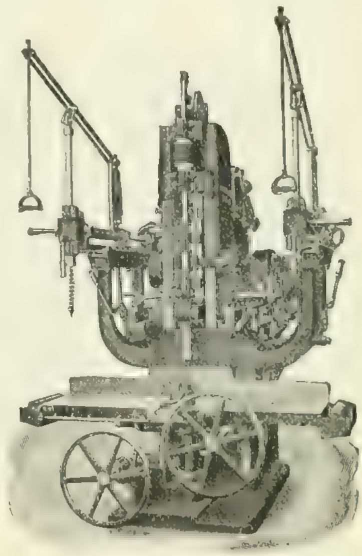


FIG. 2. HOLLOW CHISEL MORTISER.

en did not necessarily enclose the foot and it is no great stretch of imagination to see how the word hose came to mean a flexible tube, like the leather or rubber water hose with which we are all familiar. Rubber hose is now used for water, steam or air. When people save money they often hoard it in a stocking, so the saying there is money in hose is easily understood. There is money in hose in another sense, and that is in the rapid and expeditious handling of it in railroad shops. Among the economical ways of treating hose there is nothing better than the "four-function" tool called the Twentieth Century Outfit. This is a hose cutter, fitter, stripper and mounter all in one machine, with no very great change required to make it do any one of these lines of work. Write to the Buker & Carr Manufacturing Co., Rochester, N. Y., and ask them about hose, they make the machine. It is a handy one and a good one.

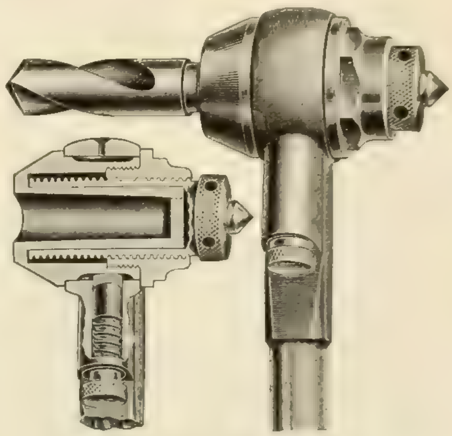
The Railway Materials Company, of Chicago, have moved their New York offices to the 30th floor of the new Singer building, which is on the northwest corner of Broadway and Liberty street. This building is the "cloud scratcher," a photograph of which appeared in our issue of November, 1907. The Railway Materials Co. handle the Ferguson Oil Furnaces, the Rymco Journal Boxes, steel back brake shoes, and other railroad supplies. The Singer building is 149 Broadway, New York.

Among the most important International Congresses to be held this year in Europe is the Eighth International Congress for the Prevention of Accidents. Its sessions are held every three years, and are always attended by the most influential governmental officials, publicists, social economists, men of affairs, and professors. The reports of the Congress are made by the most eminent world specialists, so that the volume of these proceedings is the record of the world's latest and best advance in accident prevention. Of special value will be the report of an International Committee on the Standardization, so to speak, of accidents, their causes, duration, and results, so that a world standard may be agreed upon as the basis for a comparative study. Membership in this Congress is $2, which entitles the subscriber to all the reports and the complete proceedings. The membership fee may be sent to Dr. W. H. Tolman, 231 West 39th street, New York, by whom it will be acknowledged and forwarded to Rome.

There is a little publication got out each month by the Joseph Dixon Crucible Co., of Jersey City, and in the May number they make some remarks as to what to read. Here is what they say: "If you have the 'blues,' read the 27th psalm. If your pocketbook is empty, read the 37th psalm. If people seem unkind, read the 15th chapter of John. If you are discouraged about your work, read the 126th psalm. If you are all out of sorts, read the 12th chapter of Hebrews. If you are losing confidence in men, read the 13th chapter of I. Corinthians. If you can't have your way in everything, keep silent and read the 3rd chapter of James. When your engine sticks, squeaks or runs hard and you don't know what to do, read "Graphite as a Lubricant" or "A Study in Graphite," and be happy and contented. If you haven't them we shall be glad to send them to you free of charge." We do not, of course, know for certain if the company keeps a copy of the bible in stock, but they have evidently read parts of it. We do know, however, that they have graphite, and their two booklets on it are worth getting and they can be had by simply sending a post card to the Dixon Company.

Helvco is the trade name of a very useful brand of steel. It has a high elastic limit, and this is in combination with other features, such as great tensile strength with an elongation in 2 ins. of about eleven per cent. With these characteristics it would not seem likely to be easily machined, but if the rolled or hammered bar be quickly heated to a cherry red and allowed to cool in the air it can be machined without trouble. Helvco steel, so treated, when of ordinary dimensions, will bend double without fracture. It will harden in the air without cracking or warping and its wearing qualities are excellent. This steel flows readily in dies when drop forged or in blacksmith work. It has just been put on the market by Messrs. Chandler and Floyd, 143 Liberty street, New York, who will be happy to answer any inquiries regarding Helvco steel and what it will do and how to work it.

The Armstrong Short Ratchet drill has a short head and a long feed. It is also reversible. It is a useful shop tool for use wherever holes have to be drilled in



SHORT RATCHET DRILL.

places where height of space is limited. Its short head, strength and compactness peculiarly fit it for boiler work as well as for lots of other tight corners in work about a railroad repair shop. Its parts are made from bar steel or are drop forged, the pawl and centre are tool steel, and are carefully tempered. It is a useful and handy tool and it is evident that the short head ratchet was designed by a longheaded man. If you care for descriptive circular No. 7 (and seven is the perfect number, you know), write to the Armstrong Brothers Tool Co., of 104 North Francisco Avenue, Chicago, and ask for one; they are "the tool holder people" and they have a descriptive catalogue about tool holders.

A fine catalogue of engine lathes has just come from the press, issued by the Lodge and Shipley Machine Tool Company of Cincinnati, O. We need not speak of the excellent way the

catalogue has been printed, for illustrations and letterpress are high grade, but there are interesting points and features connected with these lathes which are well brought out and which are worth perusal. The catalogue will be sent free to anyone interested upon application to the company.

The American Locomotive Company have recently received an order for one 6-wheel switching engine for the St. Louis National Stock Yards; one Consolidation engine for the Fajardo Sugar Co.; two Mallet type locomotives for the Eastern Railway of France; and one 10-ft 7-in. cut scoop-wheel type standard gauge rotary snow plow for the Paris-Orleans Railway.

The H. W. Johns-Manville Co., New York, have just issued an elegantly illustrated pamphlet descriptive of their Magic Boiler Compound, which is generally acknowledged to be a radical departure from all other boiler cleaning compounds and devices. The pamphlet describes the action of the compound in working its way between the scale and the iron, loosening the sediment, which can be readily blown or washed out. The asbestos and magnesia products of the company are also described, and all interested should secure a copy of Magic Methods, the title of the company's new catalogue.

The Boston and Maine Railroad Co. have issued a superbly illustrated pamphlet of 112 pages descriptive of New England vacation resorts. It would be difficult to imagine a more wonderful combination of physical and spiritual beauty than is to be seen and felt on the land described in this publication. Here are the splendors of mountain and valley, the gorgeous glory of forest and flowers, the flash of silvery waters, the far-shining glitter of wave-worn archipelagos, and all this haunted by historical associations and illumined by the light of the poetical genius of Longfellow, Whittier and other poets who have made New England classic land. The tired city dweller should secure a copy of this handsome brochure before settling on his summer holidays. The passenger department at Boston issue it.

Last month we called attention to a very good cleaning preparation for interior woodwork, such as office desks, tables, etc., and the interiors of railway cars. This preparation was made by Charles E. Hatt & Chemical Company. The same cleaner is on the market all right and as good as ever, but is now handled by the Morhous Manufacturing Company, 845 Front street, Detroit, Mich. If you want any information about the cleaner and polish or the combination rubbing polish write to the new address.

The American Brakeshoe & Foundry Company have removed their New York office from 170 Broadway to the fourteenth floor of the Hudson Terminal (Cortlandt Building), 30 Church street.

Mr. R. J. O'Neill, Denver, Colo., is meeting with much favor in the manufacture of his Rapid Flue Welder. The machine can be adjusted from two-inch to four-inch flues in a few minutes, and in point of rapidity is limited only by the furnace for heating. The apparatus is of the latest improved roller type and only requires to be seen to be fully appreciated.

The Hicks Locomotive and Car Works, Chicago, show no abatement in their rapidly expanding business of rebuilding railroad equipment. Their present output exceeds ten heavy locomotives per month. At the car works twelve new coaches per month are being turned out in addition to hundreds of freight cars. The prices of the second-hand equipment are such that it is no surprise that this department is running to its full capacity. The company are also earning a reputation for new work, which fairly places them in the front rank of locomotive and car builders.

The general offices of the Erie Railroad at New York have been moved to the Hudson Terminal (Fulton Building), 50 Church street. The Advertising Department of the road directs attention to the fact that they have moved to the largest office building in the world and that they occupy the largest space of any tenant. May their business and officials increase and multiply until they occupy the whole of the building.

A very interesting illustrated description of the National Boiler Washing Company's system has recently come to our office. By the method employed a compact washing plant is installed in a roundhouse. The one shown in the pamphlet is in use on the Chicago & Eastern Illinois. The steam and hot water contained in a locomotive boiler is made to heat up the water used in washing out and subsequently filling the boiler. By this means the heat in the locomotive boiler is not lost as is usually the case and time is saved in the operation of washing, and the clean boiler is filled with water at a temperature of about 190 degs. F. A thermostat is used in the system by which a temperature of about 140 degs. F. is automatically maintained while the boiler is being washed out. Anyone who is desirous of understanding this system should write the National Boiler Washing Co., Railway Exchange Building, Chicago, for a copy of their pamphlet on the subject.

The Jenkins Brothers, the manufacturers of the Jenkins' Standard '96 Packing and of the well known Jenkins Bros.' Valves, have moved their Chicago office from North Canal street to larger quarters at 226 to 228 Lake street, corner of Franklin street, Chicago.

Railway and Locomotive Engineering

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A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXI. 114 Liberty Street, New York, July, 1908 No. 7

The Maritime Express.

The principal express train on the Intercolonial Railway of Canada, derives its name from what are often called the Maritime Provinces of the Dominion. These are New Brunswick, called after the Royal House of Brunswick, Prince Edward Island, the little Province named after the late Queen Victoria's father; and Nova Scotia, which includes Cape Breton. This Province was so called by the first settlers who originally came from Scotland and Brittany. "Breton" being the name of an inhabitant of Bretagne or Brittany, in France. The Maritime Express traverses one of the most picturesque regions in the world, renowned in song and story.

The express from Halifax to Point Levis, opposite Quebec; No. 33 covers the distance in a continuous trip of 21 hours and 55 minutes, and as the mileage is 674 between these cities, the average speed is about 30¾ miles an hour. This train leaves Halifax at 15:50 o'clock, Atlantic time, which is sun time for the 60th meridian west from Greenwich. This meridian passes very close to Glace Bay, which is almost at the extreme easterly point of Cape Breton Island. The change to eastern standard time occurs at Campbellton, 371 miles from Halifax and there one hour has to be added to the running time on the westbound trip. The Intercolonial time tables are all made out on the 24-hour system, in which the A. M. and P. M. notation has no place. Our frontispiece illustration shows the Maritime Express bowling along on a high embankment

THE MARITIME EXPRESS ON THE INTERCOLONIAL RAILWAY OF CANADA.

from which a view of the beautiful Wentworth Valley is seen. The point where the photograph was taken, showing the powerful ten-wheeler with its six coaches, happens to be the highest point on the Intercolonial with the exception of the summit beyond Matapedia.

The writer remembers with keen delight the beauty of that fair region. Nothing could exceed the exquisite glow of early light one summer morning after a night of test work on the engine of a westbound freight. The light, gray at first, slowly beat back the night and made the gauge lamps

THROUGH THE FAMED MATAPEDIA VALLEY.

in the cab grow pale. The fresh, cool, morning air, the sunrise, one's senses drank in refreshment after watching for the dawn with tired eyes. Newcastle platform is ordinary enough, but it was then the vantage ground for glorious sight. The landscape bathed

The Ancient Capital, as Quebec is called, is still French. "The hand of time has swept away the ruins of Port Royal and grass grows over what was once the well-nigh impregnable Louisburg, but Quebec remains, and will remain the Niobe of the cities of France in the Western World." Opposite Riviere du Loup, is the famous old Tadousac, the most ancient European settlement in Canada and perhaps in America. Tadousac is close beside the mouth of the Sagueney, whose waters flow into the St. Lawrence, between two mountainous masses of granite, Cape Trinity, on one side with its three rounded domes high up aloft, and on the other side, the mighty wall of rock, Cape Eternity, with its sheer drop of 2,000 feet.

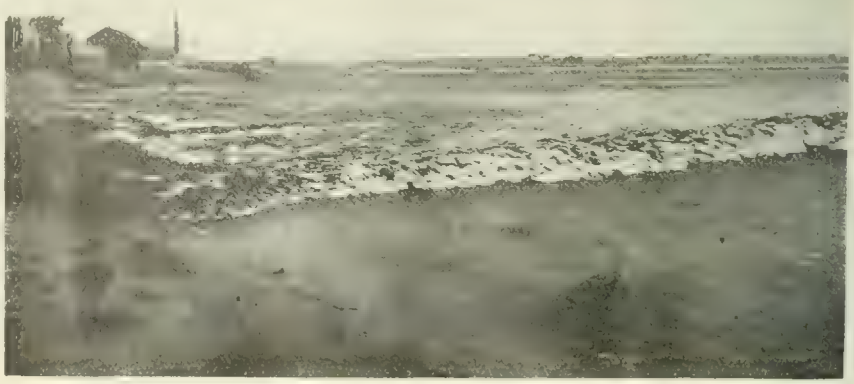
Campbellton, where the time on the railway changes, is on the south side of the boundary river, the Restigouche, between the Provinces of Quebec and New Brunswick. Leaving the St. Lawrence at Rimouski, the Intercolonial cuts across the Gaspé peninsula and reaches the Baie des Chaleurs which Jaques Cartier, the adventurous discoverer, so named in grateful remembrance of the genial warmth which he there encountered after leaving the cold waters of Newfoundland.

Then comes Newcastle, a little station not far from the Miramichi river.

in the mellow glow of morning gave that indefinable sense of depth, as of distance made clear without the glare of strong light, and without the hazy blur that comes when the dew is gone.

Moncton, headquarters station for the road, is on the Petitcodiac river. One of our illustrations shows the Bore moving steadily up the river against the natural flow of the water.

The tide at the entrance to the Bay of Fundy is about 9 ft. deep. This increases to about 28 or 30 ft. in the neighborhood of St. John, and reaches a height of something over 60 ft. at the highest, or what are called the spring tides, in the narrow terminal extremity known as the Bay of Chignecto. The high tide in the Bay of Chignecto is all the more wonderful from the fact that at the other side of the isthmus, connecting New Brunswick with Nova Scotia, a distance of 14 miles, the waters of Bay Verte only experience a tidal fluctuation of about 4 or 5 ft. The impetuous rush of water, as it sweeps up the Bay of Chignecto, enters the mouth of the shallow Petitcodiac river and gives rise to a tidal wave which follows the windings of that stream and passes up to and beyond Moncton, where the principal shops of the Intercolonial Railway are situated. This tidal wave is called "Eager," but more generally the "Bore." Some authorities believe the latter word to be derived from the Icelandic "Bara," a billow raised by the wind. The passage of the bore up the river follows some hours after the high tide has engulfed the falls of St. John and heaped up the waters in Chignecto Bay, but the time has been accurately calculated and notices are daily posted in the hotels at Moncton, giving the hour and minute of its arrival, for the benefit of travelers and sight-seers who desire to look at the wall of water, perhaps a foot in depth, as it rushes up against the river current and all at once alters the level and the direction of the flow.



THE BORE ON THE PETITCODIAC RIVER AT MONCTON, N. B.

The engulphing of the falls at the mouth of the St. John river close by the city of that name is a unique sight. St. John is almost at the entrance of the Bay of Fundy, and is about 90 miles from Moncton, on one of the four railway arms which stretch out from that point. The falls at the

mouth of the St. John river, are about 17 or 20 ft. high, and the average high water tide rises 6 or 8 ft. above the general level of the water in the natural gorge above the fall. Thus it is that twice in the twenty-four hours, for a period of about three-quarters of an hour, ships of moderate tonnage can pass over the completely submerged fall and up the river, which is regularly navigable to Fredericton, a distance of about 88 miles from St. John. There are two bridges near the city of St. John, from which a spectator may behold the curious spectacle of a waterfall literally drowned out and engulfed, and at such a time he may even see part of the water which had previously tumbled over the cataract flow steadily back over the rocky ledge and surge up into the gorge through which it had passed on its way to the fall.

Nova Scotia is the Acadia of Evangeline, and the little obliterated, but not forgotten hamlet of Grand Pré was beside the Minas Basin, in the Annapolis valley. Beyond the town of Windsor lies the great marsh meadows,—the Grand Pré. Few traces of the old French village are to be found.

MORRISSEY ROCK I. R. C.

It has vanished, but the road taken by the exiles as they sadly made their way to the ships that were to take them from their beloved land may still be traced by the lover of Longfellow's verse, and he may there see again in fancy, Evangeline, the "Sunshine of St. Eulalie."

The Grand Trunk Pacific has contracted for 600,000 ties to be supplied west of Edmonton at an average price of 40 cents a tie. They have secured sufficient ties for the road west as far as McLeod River, and arrangements are now being made for ties to extend the line to Yellowhead Pass.

The Object Lesson of the Great Rush.

By A. O. Brookside

Sam Sanderson was a great [illegible] that was his characteristic, but he was employed as an engineer on the Red Ballast & No Dust Railway, and he

BADDECK, N. S., ON THE INTERCOLONIAL RAILWAY

pulled passenger. Sam had all kinds of good luck coming his way last week. He had been told off to take the "push" over the road, which was the way he spoke of the annual inspection trip of the high officials of the railway, and he had had a chance to speak face to face with the president while they all waited in a siding for something to go by on the main line. Sam had briefly explained to the president all the hard things he had to put up with on the road and had casually referred to the permanent way as a one-horse creation of the road department.

The best piece of luck happened on Saturday afternoon. Sam's engine was wanted at the other end of the division and visions of a light run back on a glorious summer afternoon and a Sunday at home floated through his mind, for he meant to book rest when he got back and be sick if necessary, and so have the Sabbath to himself. The dispatcher, however, did not care for glorious summer afternoons and hated light runs very bitterly, so he arranged that Sam should take a train of coal cars down, and, so to speak, work his passage home.

Sam generally covered the division in three hours and a half on passenger, and he figured that if he could get home early he could attend to some private business, so at the appointed time he started with the coal train. Sam forgot he had a lot of rickety, pot-bellied old gondolas bulging at the sides and loaded ten per cent. above capacity, which is putting it very mildly, and he admired the rich coloring of the trees alongside of the one-horse creation of the maintenance of way department so much that he flew along at passenger speed and the bulgy old coal cars rattled and [illegible] behind him.

Sam felt happy. [illegible] passenger train schedule and actually began to get [illegible] by the time he reached the Halfway House station he had a hot box train of the best and most complete description, for he had covered the distance in almost passenger train time. At Halfway House there was one lone solitary car repairer, as this was a junction point. The R. B. & N. D. Railway paid half the car repairer's wages and the junction road paid the other half, but Wilkinson, the car repairer, preferred to say he was half paid by both companies.

When Sam arrived with the hot box extra, Wilkinson saw his work was cut out for him and as he surveyed the clouds of smoke arising silently in the calm, clear air from the hot boxes, he asked Sam why he required a helper engine with a train like that. Sam ignored the sarcasm and asked Wilkinson to get busy. Wilkinson became very busy and soon used up his small stock of oil and waste and all his spare brasses. Sam offered to lend him a can

REVERSIBLE FALL, ST. JOHN, N. B.

of oil and a brass or two, but Wilkinson told him that as the company had now put it up to him to oil all the cars in America he was so much obliged to them for bringing the hot ones to him and not asking him to walk all over the

continent to do his business, that he guessed he would worry along somehow. He said further that he did not like to take Sam's offer and that no self-respecting car repairer could bring himself to accept a can of lubricant from an engineer; he felt that it must be full of tainted oil.

Sam felt deeply wounded at being classed with the captains of industry by a mere hot box menial, so he proceeded to oil several boxes which Wilkinson had already fixed up and Wilkinson warned him about the sin of wilful waste. Sam catching the last word shouted that he had some waste, but Wilkinson thought that must be tainted too. When Wilkinson said he would worry along he had his own ideas of what he would do, but the worrying came later.

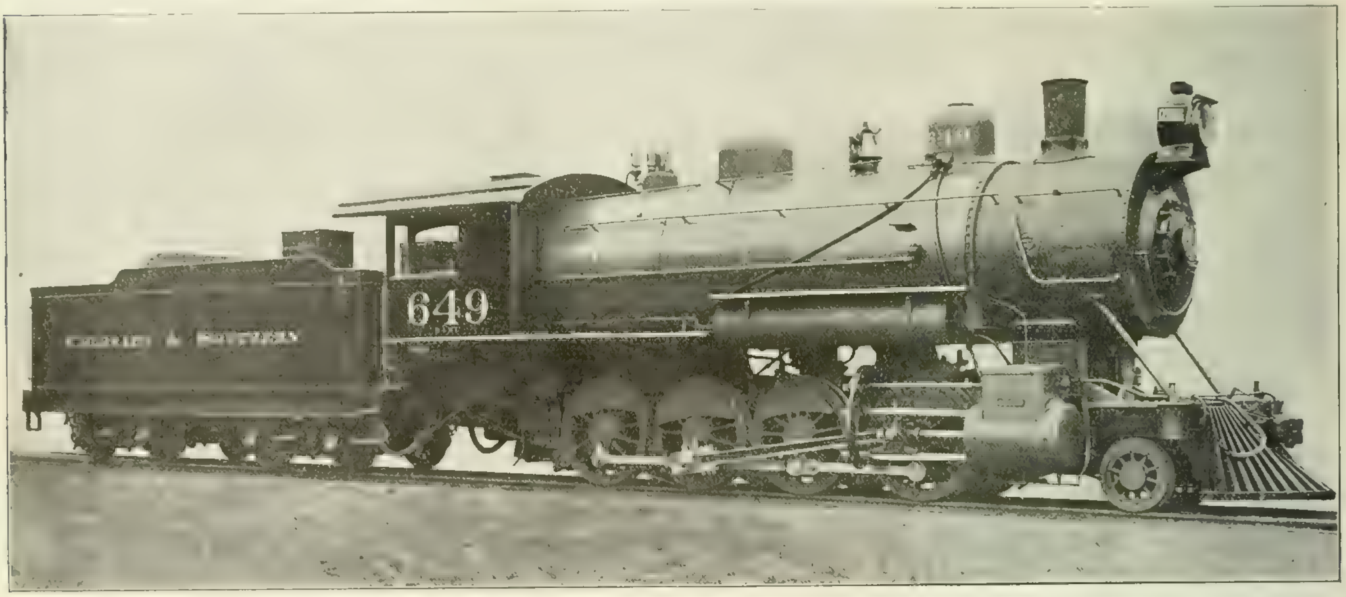
starting time from Halfway House was something over four hours after he had made the start from the terminus. Sam ran slower on the homestretch, but still fast enough to keep up the honor of the hot box extra, as he had some idea that Wilkinson's time ought to be made up. The upshot of it all was that he took the train in over the home plate hotter than a caboose stove and in about the same total time that he might have consumed running at a decent kind of speed on the beautiful summer day aforesaid. The company had not gained anything in time and were out a lot of brasses, oil, waste, etc., and Sam did not get home early enough to look after his private business.

Wilkinson's requisition for oil, waste and brasses next day cast a gloom over the stores department, and the M. C. B.'s

for private ends or a deep and dark gloom will surely overtake you, and the oil which you have helped yourself to when a car repairer's back was turned may rise up against you and make you even as one of the captains of industry.

Heavy 2-8-0 on the C. & S.

The Colorado & Southern Railway consolidation engines which we here illustrate were built at the Baldwin Locomotive Works and are good examples of modern freight power. The cylinders are simple 22x28 ins. and the driving wheels are 57 ins. in diameter. The main valves are ordinary slide valves balanced, and the motion is of the shifting link variety. The weight carried on the driving wheels is 175,250 lbs., and with the M. E. P. in the cylinders taken at 85 per cent. of the boiler pressure, the



CONSOLIDATION FREIGHT ENGINE FOR THE COLORADO & SOUTHERN.

H. C. Van Buskirk, S. M. P. and Car Dept. Baldwin Loco. Works, Builders.

Wilkinson still had quite a number of boxes to repack and he proceeded to help himself to oily waste and some brasses from the cars belonging to the junction road, and after he had robbed Peter to pay Paul to a considerable extent he thought Sam ought to be able to arrange to think about starting again. In the mean time the dispatcher had asked what was keeping the coal train and Sam gave a splendid explanation, which cast a deep shadow all over the whole car department of the road and particularly on the honesty, integrity, ability and fidelity of the oilers at the terminus, which he intimated had sent out a very heavy coal train without oil, waste, brasses, wedges, or indeed anything that a very heavy coal train ought to have.

Sam had been about two hours on the road and Wilkinson's work had taken about two hours, so that the train's

letter of the "please-explain" quality cast a gloom over the Halfway House for a few minutes, but Wilkinson's reply caused a dark, sunset shadow to fall over Sam, and the train dispatcher deepened the gloom by his remarks, and the maintenance of way department blackened it into night when they told of the great and many stray lumps of coal to be found along what they called the track, and when Sam said he was sick at the roundhouse everybody told him he looked it, and he eventually got some rest without the trouble of booking it.

Moral: It is better to be a humble railroad man than a great rusher, and it is always wise to study the habits and ways of old-fashioned coal cars. Do not refer to even a poor, neglected siding as a one-horse creation, when speaking to the president, and above all things never try to get home quickly

tractive effort of the engine becomes about 40,400 lbs., and as it has 175,250 lbs. on the drivers the ratio of tractive effort to adhesive weight is as 1 is to 4.3.

The driving wheels are very closely placed with reference to each other, so that the rigid wheel base is practically as short as it can be made with the size and number of driving wheels. The driving wheel base is 15 ft. 4 ins., made up of two spaces 60 ins. long between main, trailing and intermediate wheels, and 64 ins. to the leader. The engine truck is 8 ft. 4¼ ins. ahead of the centre of the leading driver and this gives the engine a total wheel base of 23 ft. 8¼ ins. All the wheels are flanged and the engine truck carries a weight of 19,400 lbs., which gives a total weight of the whole machine of 194,650 lbs. The spring system is arranged so that the leading and intermediate drivers are equalized, to-

gether with overhung springs and these wheels are equalized with the engine truck. The main and trailer wheels are equalized together with driving box equalizers, a semi-elliptic spring between them situated between the frame bars and coil springs at the outer ends of the box equalizers, the whole forming a very strong and durable combination.

ANGUS SINCLAIR, Doc.Eng.

The boiler of the engine is of the straight top type and is 80 ins. diameter at the smoke box end. The thickness of the sheets are 13-16 ins.; and the working pressure carried is 200 lbs. to the square inch. The firebox is not particularly wide, being 39¼ ins. It is 120 1-16 ins. long and the mud ring slopes toward the front, the box being 80 ins. deep at the tube sheet and 77 ins. deep at the back. The water space surrounding the firebox is 5 ins. at the front and 4½ ins., back and sides. The heating surface is firebox 209 square feet, tubes 2,346, total 2,555 square feet. The grate area is 32.7 ins., which gives a ratio of grate to heating surface of 1 to 78. The tubes in this boiler are 334 in number; they are 2 ins. in diameter and each is 13 ft. 6 ins. long. The firebox is radially stayed and the firebox sheets are ⅜ ins. thick with the exception of the tube sheet, which is 9/16 ins. thick.

The tender frame is made of structural steel and arch bar trucks are used. The tank holds 8,000 gallons of water and carries 10 tons of soft coal. Some of the principal dimensions are as follows:

Boiler—Material, steel; fuel, soft coal.
Fire Box—Material, steel
Tubes—Material, steel; wire gauge, No. 12.
Driving Wheels—Journals, main, 10 x 12 ins.; others, 9 x 12 ins.
Engine Truck Wheels—Diameter, front, 30½ ins.; journals, 6 x 10 ins.
Wheel Base—Total engine and tender, 56 ft. 2½ ins.
Weight—Total engine and tender, about 350,000 lbs.
Tender—Wheels, diameter, 33½ ins; journals, 5½ x 10 ins.; service, freight.

Keep your temper, nobody else wants it!

Angus Sinclair at Purdue University.

At the Commencement exercises held at Purdue University, Lafayette, Ind., on the 10th of last month, President Stone introduced Angus Sinclair, of New York, and said: "The Faculty of this University has unanimously decided to honor itself by conferring the honorary degree of Doctor of Engineering upon Angus Sinclair, famous engineer and author. This degree is given but rarely and only by technological schools of the first rank. It has been conferred by Purdue only once before, viz: to Ellwood Mead, an alumnus.

"The recipient of to-day's honor is a native of Scotland and a citizen of the United States for many years, who has distinguished himself as a student and writer in the field of engineering, particularly that relating to railway practice. He is editor and publisher of RAILWAY AND LOCOMOTIVE ENGINEERING and the author of exhaustive treatises on the following subjects: Locomotive Engine Running and Management; Combustion in Locomotive Fire-Boxes; Combustion and Smoke Prevention; Burning Soft Coal Without Smoke; Firing Locomotives; Twentieth Century Locomotives; History of the Development of the Locomotive Engine, and numerous other publications." President Stone then handed Mr. Sinclair the diploma of Doctor of Engineering.

Purdue University was organized under an act passed by United States Congress in 1862 and is the State University of Indiana. The University embraces seven special schools, as follows: School of Agriculture, School of Science, School of Mechanical Engineering, School of Civil Engineering, School of Electrical Engineering, School of Pharmacy, School of Medicine.

At the recent Commencement, 262 graduates received bachelor degrees. About 1,500 people were present at the exercises. Purdue University has for about twenty years devoted special attention to railway engineering, more especially to the department of motive power and rolling stock. Their locomotive testing plant is the finest in the world.

No Substitute for Work.

It is an old saying that what costs nothing is of little value. This is true in the matter of gaining knowledge. Dr. Henry Van Dyke, professor of English in Princeton University, when addressing the University Club of New York, said:

"What a man gets into his head without serious effort he does not really learn. He merely possesses it in his memory as a parrot does, and it would be a totally valueless factor to him, a thing of no consequence.

"All short cuts to an education are not only false, but injurious to the individual and of the greatest possible injury to the community in which they exist. It is all tommyrot and nonsense, this outward pretense of learning.

"The only way to master knowledge is by hard toil. There is no royal road or automobile road to education. You have to hoof it."

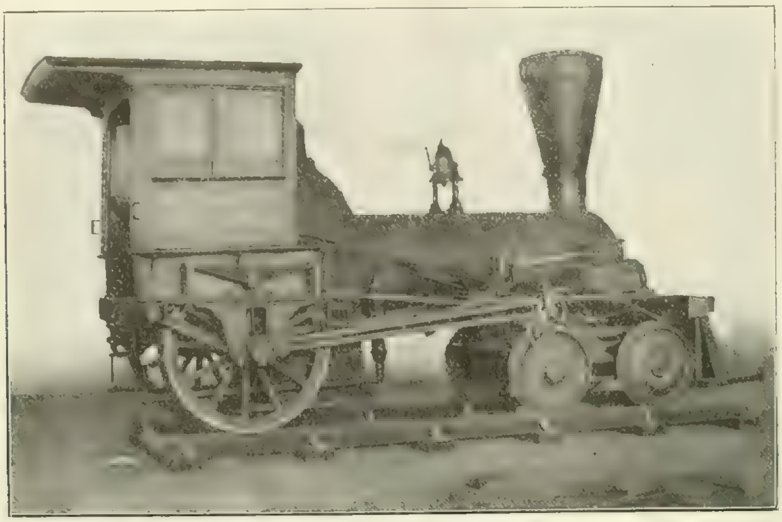
ENGINEERING BUILDING, PURDUE UNIVERSITY.

Much the same idea is to be found in an article by Dr. Karl Drews, quoted in *Current Literature*, in which he says, "Workshop practice means hard work and blistered hands, and kid gloves are perfect non-conductors of technical knowledge."

The Pioneer.

Through the courtesy of Mr. W. B. Kniskern, passenger traffic manager of the Chicago & North-Western Railway we have been favored with an excellent photograph of an interesting old time engine called the "Pioneer," from which our illustration has been made. Speaking of this engine Mr. Kniskern says in a letter to us:

"'The Pioneer' was the first locomotive used by any line out of Chicago.



THE FAMOUS OLD "PIONEER"—C. & N. W. RY.

It reached Chicago on a sailing brig in 1848, and was drawn across the city by horses and placed upon the tracks of what is now the Galena Division of the C. & N. W., then known as the Galena & Chicago Union Railway. It made its first trip in November, 1848, with a party of prominent people, and on the return trip a farmer with a wagonload of wheat hailed the train, and 'The Pioneer' on its return trip brought to the city this, the first rail shipment of grain, to the Chicago market. Similarly, a few days later, a drove of hogs was transferred to the railway a few miles outside of town, and thus became the forerunner of the livestock shipments for which the city is to-day noted. 'The Pioneer' to-day occupies a place of honor in the Field Columbian Museum in this city."

The credit of having saved this historic engine from being scrapped must be given to Mr. Marvin Hughitt, president of the Chicago & North Western. By his sensible act in saving 'The Pioneer,' Mr. Hughitt introduced a new fashion which is still popular and has saved many interesting articles from the melting pot.

In describing this engine in his well-known work, "The Development of the Locomotive Eugine," Mr. Angus Sinclair says: "The first locomotive to raise noise echoes in Chicago was 'The Pioneer,' whose antique appearance is familiar to people who visit the Field Museum in Chicago. The engine is well worthy of careful examination by people who appreciate the great benefits conferred upon humanity by the locomotive engine.

"After tedious research I have succeeded in tracing the history of this old locomotive, which is an object of keen interest to many people, especially those about Chicago. 'The Pioneer' was the thirty-seventh locomotive built by M. W. Baldwin and was turned out in 1836 for the Utica & Schenectady Railroad. After a few years of service in the Mohawk Valley the engine was sold to the Michigan Central Railroad, where it was known as 'The Alert.' While in Michigan a few changes were made on the engine. As originally built it had a single fixed eccentric for each cylinder with two arms extending backward having hooks to engage with a pin on a rocker arm which actuated the valve rod. That motion was removed and double eccentrics with V-hook put in its place, the motion now found on the engine.

"When the Galena & Chicago Union Railroad Company were ready to begin track laying in 1848, they bought 'The Alert' from its owners and called it 'The Pioneer,' a proper name for the first locomotive to perform service west of the lakes. 'The Pioneer' is the same type as Baldwin's second engine, 'The Miller,' long a favorite pattern with Mr. Baldwin, but is larger and has two inches longer stroke, but the other details are the same except the improved valve motion."

'The Pioneer,' when being repaired in the shop in 1855, was equipped with a feed water heater. Mr. R. W. Bushnell, who was for many years master mechanic of the Burlington, Cedar Rapids & Northern, in a letter containing many interesting reminiscences of 'The Pioneer,' writes thus of the feed water appliance: "The heater consisted of vertical pipes placed around the inner side of the inside pipe of the smoke stack and connected at top and bottom by return bends, the pump forcing the water through these pipes to the boiler. The stack was of the ordinary pattern for wood burners in those days, but to get ample surface for the water heater, the inside pipe was made very large to get as many pipes in as possible. To cap this and to retain heat in the stack the cone was made unusually large."

Boiler Makers' Convention.

At the recent convention of the International Master Boiler Makers' Association, held in Detroit, Mr. George Wagstaff, supervisor of boilers on the New York Central Lines, president of the association, said in his opening address:

"The importance of correct principles and good workmanship in boiler construction cannot well be overestimated. The steam boiler is today the most potent factor in our complex civilization. Wherever you find man is civilized you find the steam boiler. When we get down to nature, it will be found that the final link between the energy in the coal pile, and its transformation into useful work is our old friend, the steam boiler. I point out the wide application of our work, not in a boastful manner, but merely to show the universality of our calling, that we may realize our responsibilities and be governed accordingly. Strict adherence to established rules and formulas should be the guiding principle of boiler making, and under no consideration should a boiler maker deviate from those well-known laws of accuracy and safety."

The secretary of the association, Mr. Harry D. Vough, of New York, in his annual report said:

"The effort of the year has been to establish a working basis and perfect system in order that later progress may be conducted upon a solid foundation and along correct lines. It has required a careful consideration of manifold details. Important problems required solution; rough spots had to be smoothened, troublesome obstacles removed, and records opened in such intelligible form that they would hereafter be comprehensive and reliable. All this, however, has been achieved. The present membership of the association is 337, with a number of new applications to be passed upon."

Mr. Frank Gray, of Bloomington, Ill., treasurer, made his report, showing a substantial surplus.

Manners are not idle, but the fruit
Of loyal nature and of noble mind.

—*Tennyson.*

General Correspondence

Some Strange Passengers.

Editor:

The professional railroad man, be he trackman, or foreman, or conductor, or locomotive engineer, is sure to meet with many peculiar people, and many unusual experiences, in the course of his career, no matter where his lot may be cast. The monotony of the daily round of his life is quite likely to be broken in upon by many unexpected happenings. What is coming next he seldom knows.

How little we know, even in regard to the very railroad itself, is well illustrated by the following: It is said that at the time when the Santa Fe was completed and ready for traffic, one of the wise ones remarked: "Well, there is one thing about it, they won't need any sidings on the road, for one train will be able to take care of all the business they'll have for the next three hundred years to come!" Some fifty of the three hundred have now passed, but what passenger on the magnificent trains of this road as they roll out of Chicago for the West would care even to venture a prediction of what still awaits this great enterprise in the remaining two hundred and fifty.

Every now and then someone presents himself who insists on riding on the engine. To be sure it is against the rules of the road, but he is an official, or has obtained permission from some one high in authority, and there is no deterring him. His curiosity is unbounded, and he must know what every cock and valve and lever is for, and test them all. He must blow the whistle and ring the bell, while close watch is kept that he does not "get into mischief," or fall from the cab as curve follows curve.

Then there is the "bull-headed" passenger, who is ever getting into trouble through ignorance or stupidity. Not long since the writer saw one such go through a most thrilling experience. He ran up to catch a train, just as it was drawing out of the station. He approached from the wrong side, of course, and seizing the railing as the train was rapidly gaining headway, leaped upon the steps of a vestibule Pullman. The door was closed and he did not know how to, or could not, open it. Meantime the train had gathered such speed that he dared not let go, and there he hung, in imminent peril of his life. A picket fence divided the inner and outer tracks, and extended the entire length of the station. Again and again as the wind flapped his overcoat about, its skirts narrowly escaped catching on the sharp pickets. Had they done so, he would have been torn from his hold in an instant and rolled under the wheels. Hundreds of passengers looked on aghast, expecting to see him hurled to destruction at any moment, but fortunately the ever-watchful eye of the engineer took in the situation at a glance, as he chanced to look back for a moment, and in a twinkling the air brake was applied, and the man removed from his dangerous position. It is safe to say that he will never try that experiment again.

And thus all sorts go to make up the engineer's load. Perhaps the most undesirable load of passengers on record is that told about by an engineer of the southwest. It was in the early days, when the railroads of the plains were under construction, and his haul consisted of a construction train at the most advanced end of the line.

One eventful morning he had just hauled out his train, made up of a shift of gravel cars and one box car filled with tools, equipment and so on. The gravel had just been unloaded, and the men were busily spreading it with their shovels, when of a sudden someone shouted, "Injuns!" Sure enough! A great number of them were riding over the prairie at a furious gait, their dreaded war whoop ringing shrilly as they came on like a whirlwind.

"Jump into the box car, quick, boys!" shouted the resourceful engineer, as he withdrew his person as far as possible within the cab that his presence on the engine might not be suspected by the dusky warriors.

It was a moment of intense excitement and suspense for the crouching form in the cab, waiting with hand on throttle and bated breath to make sure that all were safely aboard. Even as the door of the car was pushed to, behind the last fugitive, the murderous band dashed up. Furious with rage that their intended prey should thus have escaped them, a score or more leaped from their horses and swarmed over the gravel cars and up onto the top of the box car. But already the hiding engineer had thrown open the throttle to its utmost, and the train was beginning to back away at an ever increasing rate of speed. The Indians were all astonished beyond bounds at this, unable to account for the motion, and never once suspecting the engine as the cause of it, or ever guessing that it was occupied.

Faster and faster flew the train, until

PABINEAU FALLS ON THE NEPISQUIT RIVER INTERCOLONIAL RAILWAY.

a furious rate of speed was attained. The road, being new construction, was exceedingly rough and uneven, and the cars dashed madly about, like a ship on a stormy sea; but the intrepid engineer withheld his hand, and let them pitch and plunge as they would, in his wild run to save his men from harm. Meantime the warriors on the cars, partly through sheer fright, partly as a result of the unwonted motion, one after another lost their hold, and rolled to the ground below and were left behind in the sage brush, only too glad to escape from their perilous position. When the plucky engineer, by peeking cautiously over the top of the tender, had made sure that the coast was clear, he slowed down his train. Not one of the dusky passengers with whom he had set out remained aboard at the end of his wild run. But none ever criticised him for that. A message from the nearest station quickly brought some of Uncle Sam's bluecoats to the scene, whose presence always had a wholesome effect upon "bad Indians."

R. B. Buckham.

Salem, Mass.

Good Engine Record.

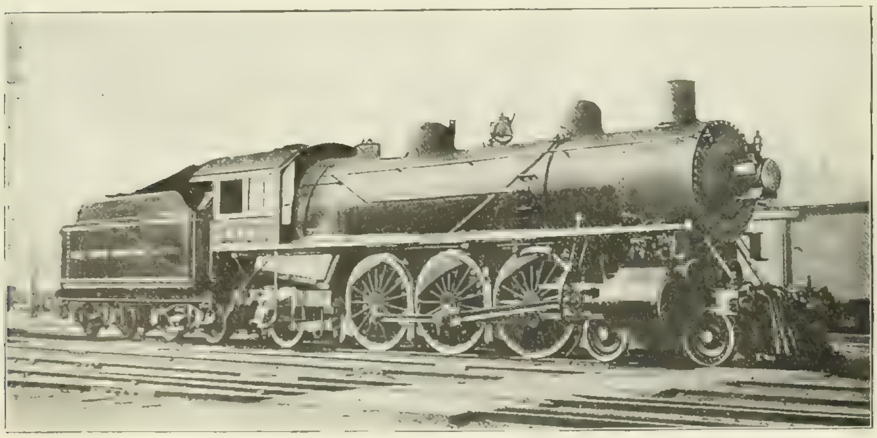
Editor:

I enclose to you a photograph of M. C. R. R. locomotive, No. 8450, which has made a very good record between general repairs. This locomotive was turned out of the shop March 24, 1907, and made 890 miles in freight service before being placed on her regular run, between Jackson and Chicago, in passenger service. April 2, 1907, the engine was placed in passenger service, hauling trains Nos. 23 and 36, each train consisting of about 425 tons exclusive of the locomotive.

On May 2, 1908, locomotive was taken into the shop, after having made 147,451 miles; 145,561 of which were in passenger service. This gives an average of 11,274 miles per month. This mileage was made without change of flues, also without having the engine off her driving boxes. There are three engineers on the run regularly, Mr. Frank Billings, Mr. A. T. Austin and Mr. Christner, each of these gentlemen are responsible to a very large extent for this good performance.

J. E. Parks,
Div. M. M.

Jackson, Mich.



HEAVY 4-6-2 ON THE LAKE SHORE.

Air Heating Apparatus.

Editor:

I should like to point out to you that one of the points raised by Mr. W. E. Wiley in the General Correspondence columns of your May issue, namely, the heating of the air for combustion before it it admitted to the fire, is now being tested in England on the London, Brighton and South Coast Railway. The arrangement is the patent of a Mr. Hammond and consists of two large casings on either side of the upper part of the smoke box containing a number of tubes open to the atmosphere at the leading end.

The interior of the smoke box itself is divided into two chambers, an upper and lower. The exhausts takes place in the top one and the gases of combustion are drawn through among the air tubes, heating their contents, which are constantly displaced by the motion of the engine forcing them back to below the firebars, where they are admitted to the fire.

I cannot say yet how the device is working, but I think that this note may interest some of your readers, as the subject has now been raised.

The locomotive fitted, is an 18½x26 in. cylinder, 6 ft. 6 in. wheel, four-coupled in front, type similar to that illustrated in Sinclair's Development of the Locomotive Engine.

T. H. M. Slocombe.

Cookstown, Ontario.

Question About Walschaerts Gear.

Editor:

Regarding your answer to question No. 46, in June number of Railway and Locomotive Engineering, I understand why such a change was made after studying same out, but the misleading feature of this gear to me and possibly to others, is the fact that on page 62 of book entitled, The Walschaert Valve Gear, by W. W. Wood, he states, "With engines of the American type you can always tell, therefore, whether an engine with Walschaert gear has outside or inside admission valves by noticing the position of the eccentric, in reference to the main pin and the method of connecting the valve-stem and radius rod on the combination lever."

He having stated in a previous paragraph that with inside admission, engines with Walschaert gear, the eccentric will always follow main pin, instead of leading main pin as with outside admission valves. Also, that radius rod will be connected to combination bar above valve-stem, with the Decapod engine, spoken of in question No. 46, the connection of radius rod with combination bar holds good, as Mr. Wood states, but the eccentric leading the main pin does not hold good, as Mr. Wood states, eccentric will follow main pin with inside admission valves.

After reading Mr. Wood's book, the difference in gear in decapod engines spoken of, was a puzzle to me as to whether engine was outside or inside admission, but after studying out the fact that valves are inside admission, I found Mr. Wood had made the mistake, and this same might possibly mislead others.

If convenient, would like to hear from Mr. Wood on this through the columns of your journal.

Miles Gibson.

Mt. Carmel, Ill.

Industry at Youngstown.

Editor:

I was recently in Youngstown, O., delivering two locomotives built by the Baldwin Locomotive Works. They were for heavy switching service, weighing about 90 tons. Engines proved very satisfactory. I was much impressed with the building operation.

The company having set aside two million dollars to build an open-hearth furnace. Some of the finest machinery that the writer ever saw is being instaled in this plant. The demand for open-hearth steel being so great that this step was decided upon. The works are somewhat backward owing to financial conditions. They expect to have the furnaces ready by August. They

will have a capacity of 400 tons per day. The writer was pleased to see this industry in such a healthy condition. They are working 3,800 men, and have been fairly well employed. This is, without doubt, the best town in the State for work. They make a very high grade of pipe here, and when their furnaces are finished they will have as fine a plant as is in this country. The name of the firm is the Youngstown Sheet & Tube Company.

G. M. H. Jackson,
Traveling Engineer, B. L. H.
Philadelphia, Pa.

WESTERN MARYLAND MOGUL NO. 75.

Old-Timers of the Rail.

Editor:

Noting with interest your recent excellent articles on old locomotives and their history, I take the liberty to send you, under separate cover, two unmounted photographs of old locomotives, which, on account of their age, and still in service, I thought would probably interest you and your readers.

The small photograph is one of locotive No. 75, of the Western Maryland Railroad, built by the Baldwin Locomotive Works in the year 1884. The other one is locomotive No. 3, of the Georges Creek and Cumberland Railroad, built by the old Pittsburgh Locomotive Works in the year 1879. This road was recently absorbed by the above road, and this locomotive was up until a short time doing yard duty in the yards in this city. Should you consider these of sufficient interest, I should like to see them in Railway and Locomotive Engineering.

Louis J. Lapsley,
Telegrapher, Gen. Offices B. & O.
Baltimore, Md.

On Railroading at Home.

Editor:

In your June number Mr. F. A. Baker has some very severe things to say against the common practice of railroad men making things connected with their works the subject for conversation at home. He says: "There is scarcely a more reprehensible practice; it is wrong in every way."

I am one of the unfortunates, as viewed from the standpoint of your correspondent, who was brought up in a railroad man's family where shop was talked very much and it never struck me that I and my brothers and sisters had been victims of a vicious habit until Mr. Baker denounced so vigorously the type of conversation and intercourse that permeated my childhood and boyhood home. There must be inherent wickedness in my nature, for as long as I remember, I listened with avidity to the railroad topics discussed by my father and his friends, and oftentimes after the detested order, "Go to bed, Jack," was given, I have lingered at the top of the stairs listening to the talk and tales that were relished more than my most entertaining story books.

The most ambitious visions of my young mind had me doing heroic deeds as an engineer with my eagle eye upon the track, detecting the presence of washed out bridges in time to save a train load of passengers from destruction through my superhuman efforts of throwing her into the [illegible], while squealing for brakes. Alas, a less romantic life became my reality. While I was impatient for the day, when I should become a knight of the scoop and make myself popular for keeping her hot, my father was working out other plans for my future career. Although valve motion and similar things were his favorite subjects of conversation at home when congenial friends visited the household, he had ideas which Mr. Baker would consider more elevating than shop talk. He believed in diversity of occupation in a family, and as two sons were already working for a railroad company, he told me that nature had intended me for a tailor. It is needless to repeat the painful arguments he used to convince me that I never would make a decent engineer. My mother had a brother who was prospering in the tailor business and to that work I went reluctantly. I have never, however, regretted the selection made by my father on my behalf. In clothing others I have saved enough to keep myself clothed the rest of the journey.

GEORGES CREEK & CUMBERLAND CONSOLIDATION NO. 3.

But I shall cherish romantic aspirations of the higher fate that might have been mine as a railroad engineer. And my mind often wanders back again to the delightful home-circle conversation that first stirred my ambition to dare and to do. These conversations are vaguely mixed up with driving wheels, main rods, pistons, eccentrics and leaky flues, but there were echoes of real life about them that makes me hot at the suggestion that their use was an outrage on the family.

My father, sensible man, encouraged me to take a course of art studies before learning my trade. That gave me some knowledge of art and it has been my privilege to associate, more or less, with artists in studios and in their homes. I wonder if your correspondent has any idea of the subjects of home conversation among artists? I can tell him. It is art—their business. In my own profession the fashions of dress provide the principal themes of home conversation. I might enlarge on this subject and cite examples of shop talk among all sorts of professional people, which show that human beings are always human and seldom stray beyond the influence of their environments. Shop talk is better than personal gossip, which readily descends into scandal. Thank God for rearing me in a household where the talk and conversation was clean even if it related principally to engines and cars and signals and track, with touches of the peculiarities of the living entities that managed these appliances.

John B. Hillson.

Philadelphia, Pa.

Care of Boilers.—The Flues.

Editor:

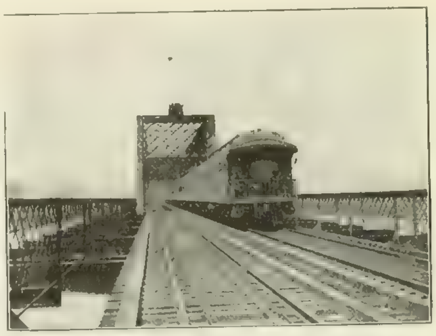
In glancing over the proceedings of any convention composed of mechanical men connected with railways, we find that one of the principal topics of discussion to be the boiler of the locomotive. This, of course, occasions no surprise, as we are all aware that without the boiler the locomotive would be useless. Given a good type of boiler making plenty of steam, the condition of the machinery need cause but little anxiety so long as it will continue to hold together, and if the valves and cylinder packings are not blowing too badly, the engine will pull cars. But given an engine with first class machinery and a poor, leaking boiler, and consequently, little steam, the condition of the machinery is of but little aid in getting a train over the road; therefore, the first consideration is the boiler and its parts.

The parts of a locomotive boiler that are most apt to fail, and when failing, are most detrimental, are flues and stay bolts, the principal item being flues. The failure or leakage of flues obtains considerably more during the winter than during the summer months, and for this reason, it is essential that we know the cause of the failure in order that we may take the proper measures to correct them.

Much has been said and considerable has been written at various times, many different theories have been indulged in an explanation of flue failures. As a rule, where the water is bad it is usually taken as a matter of course that the water alone is responsible; in fact, too much has been taken for granted in this respect. The

ERIE YARD AT PORT JERVIS.

advocates of the bad water theory bolster up their argument by the fact that the treating of water overcomes, to a large extent, the flue failures. While there is no question but that water treatment will reduce failures, yet the failures are not always due directly to the water, but to the manner in which the engine must be handled, or is handled, on account of the water. This may sound rather paradoxical, but the point intended is that with the proper handling of the locomotive, the bad water would not affect it as materially as is generally supposed. Among the many theories advanced as to the cause of flue leakage in locomotive boilers, the best and most plausible that has been brought



OVERLAND LIMITED ON THE U. P. CROSSING THE MISSOURI.

forward was contained in the paper on "The Care of Boilers," by Mr. M. E. Wells, and read before the Western Railway Club in November, 1905. Mr. Wells claimed that boiler leakage was due almost entirely to the variation in the temperature in the boiler, due to injecting feed water when the boiler was at rest, or in other words, when the water in the boiler was not in circulation. As stated above, Mr. Wells' theory was very plausible, and he brought out forcibly many facts in connection with the difference in the temperature of the various strata of water in the boiler to prove his theories; and while no doubt there is considerable merit in his arguments, we are as yet far from being convinced that this difference in temperature is the real cause of leakage, or, in fact, that it has any material bearing on the subject.

Whenever we come in contact with a certain condition, we should be absolutely sure as to the cause of this condition in order to apply the proper remedies, and for this reason we are laying considerable stress on the cause of flue leakage in order to add force to our argument as to the remedy necessary.

Having had considerable experience with locomotive boilers in various sections of the country, and feeling experienced in the handling of all kinds of water, good, bad and indifferent, the question of the cause of flue leakage has always been an interesting one to the writer, and for this reason, different experiments were undertaken in order to determine, if possible, what was the most prolific cause of leakage. At the last Master Steam Boiler Makers' convention, the question of flue leakage was discussed, and it was there decided that more flue troubles were due to poor handling of the engine on the road by the engineer and fireman than were caused by poor work in the first place. In fact, the sense of the convention appeared to be that neglect on the part of the engineer and fireman was the principal cause.

We regret that we cannot agree with either Mr. Wells or with the majority of the Master Steam Boiler Makers, as the result of quite a number of experiments made by the writer proved conclusively that flue leakage was not due so much to the abuse on the line of road by the engineer and fireman as by the abuse at terminals. This abuse being the admission of cold air and the too frequent washing of boilers. In a series of experiments it was found that by knocking the fire out and leaving the water in the boiler, allowing it to cool off gradually through the natural circulation of air through the tubes, that the flues contract considerably more than the boiler in their initial contraction. This was found to be due to the flues being exposed direct to the cold air currents passing through them, while the boiler was protected by the lagging on the outside and water on the inside. At first glance it may be thought that the heat contained in the water would naturally be imparted to the flues so that they would retain the same temperature as the water, regardless of the amount of air circulated through them. It has been found, however, that scale on a boiler tube offers considerable resistance to the passage of heat from the flue to the water, and consequently, it must offer the same resistance from the water to the flue. In other words, the scale is simply an insulating medium. After the boiler undergoing

the test had been allowed to stand six hours and steam had been reduced from 135 lbs. to 6 lbs., with a reduction in the temperature of the water from 358 to 233 deg.., is was found that the flues had contracted 9/64 of an inch, while the boiler had contracted 11/64 of an inch. Thus it will be seen that when the boiler first began to cool, the flues contracted 1/32 of an inch more than the boiler, but that in the final contraction the boiler contracted 5/64 of an inch more than the flues.

These experiments were continued with different engines and under different conditions, and in all cases the results were found to be practically the same—that is, that the flue leakage was caused almost entirely by the admission or circulation of cold air through the flues after the fire has been knocked. The variations in contraction between the flues and the boiler obtains just the same, regardless of whether the water was allowed to remain in the boiler or was entirely drawn off. In one test made after knocking the fire, we let the water out of the boiler and found the temperature of the boiler at that time to be 172 degs. Prior to letting out the water, measurements of the flues and boiler were taken. After the water was all out, measurements were again taken, and we found that the boiler had contracted 10/64 of an inch, the top flues 9/64, the middle flues 11/64, and the bottom flues 11/64. After standing three hours, the boiler was filled with water at 98 degs. and measurements again taken. It was now found that the total contraction of the boiler was 20/64 of an inch, top flues 18/64, and bottom flues 19/64. This proves conclusively that knocking the fire produces a pushing and pulling action of the flues in the flue sheet, and, as the flues are exposed to the greatest amount of heat at the firebox flue sheet, the loosening of the flues will naturally take place at this point. Cases have been noticed, however, where flues were not firmly set in the front flue sheet that they were pulled forward and back in this sheet.

From the above experiments and results obtained, the theory was formed that the principal cause of flue leakage was due to the circulation of cold air through the flues. This theory is borne out by the fact that many cases have been noticed where engines that were giving trouble on account of leakage while in through freight service, were afterwards placed in work train service and held out on line of road, gave comparatively little trouble afterwards, as, while held out on line of road, the fire was not knocked, but simply banked when engine laid up at night, whereas, while engine was in through freight service, the fire was usually knocked at terminal. The theory is further supported by the fact that where bad water obtains, making it necessary to wash engines at the end of each trip, if the water is treated chemically so as to precipitate the incrusting matter in the form of sludge, and this sludge is blown out by means of blow off cocks, and the boiler, instead of being washed at the end of each trip or at the end of every three to six hundred miles run, is now allowed to run between fifteen to even thirty days between washings, the flue trouble decreases in a corresponding ratio as the decrease in boiler washings. Remarkable decreases in flue leakage have been noted where bad water has been treated chemically either before or after the water was put into the boiler, the decrease in leakage, however, was not due to the chemicals put in the water, but to the fact that owing to the chemical treatment, it was possible to run engines longer between washings, thereby decreasing the number of times necessary to knock the fires.

If the above theories are accepted as correct, the natural conclusion will be that the proper care of boilers resolves it-

ORIGINAL TICKET OFFICE OF THE NEW CASTLE & FRENCHTOWN RAILROAD, BUILT 1832.

self into knocking the fires as few times as possible. In other words, when engines arrive at terminals, instead of knocking the fires, simply clean and bank same, leaving the fire door shut as much as possible. After the fire has been cleaned and banked, the ash pan dampers should be closed except when necessary to replenish the fire with fresh fuel. In this case the dampers should be open before the fire box door is open. In order to accomplish this the chemical treatment of water is strongly advocated, as, by this treatment, it is possible to run engines longer between washouts. When necessary to knock a fire, however, in order to wash boiler, or to make repairs to the interior of the firebox, grates, etc., the stack should be covered with a metal plate immediately after the fire has been knocked and the engine housed. In order to prevent sweating and clogging of the netting in the front end, this stack covering should have an opening, or hole, in it about one inch in diameter so as to permit the slow escape of the moisture laden gases, which would naturally form.

In the course of time flues on account of continuous service and the pushing and pulling action above referred to, owing to repeated coolings, will naturally become somewhat loosened in the sheet, and consequently begin to leak. When this leakage begins to take place, we do not advocate the rolling of flues, but prefer a light "Prosser," after which the flues should again be beaded down.

There is another very strong argument to be advanced in favor of chemical treatment of boiler feed water, and that is that when water is treated, either before or after it is put into the boiler, and the solid matter precipitated in the form of a sludge that can readily be blown out or removed by washing, there is not that tendency for solid or incrusting matter to work itself between the various joints of the boiler, such as the joints made between the flue and flue sheet, or by the firebox seams, etc., which, owing to the expansion and contraction of the boiler, will gradually have a tendency to force the sheets apart wherever this incrusting matter enters, and so with every change of water have a tendency to cause excessive leakage; as in changing water, either by running the engine on a different district from where it had been in service, or, owing to the natural changes which take place in the water with the change of the seasons where surface water is used, the change in the water will have a tendency to dissolve the incrusting matter that has already formed, and owing to the sheets and other joints having been forced apart by this incrusting matter, leakage is bound to occur.

Our knowledge of what actually does take place in a locomotive boiler in service is comparatively limited, and it is a subject worthy of the deepest thought by all men who have anything whatever to do with locomotive boilers. In this article the question of flues alone has been considered. In some following articles, which I would like to write, the question of stay bolts, etc., will be taken up showing some strange conditions noticed in regard to the breakage of stay bolts, the object being to start a line of investigation in the direction pointed out, with the intention of finally locating the true cause of boiler trouble; as, after the causes have been determined, the remedies will be obvious.

F. P. Roesch.

Spencer, N. C.

Class for Apprentices.

Editor:

The Chicago, Indianapolis & Louisville Railway have started a class of appren-

tices at their shop at La Fayette, Ind. They hold their meetings in Air Instruction Car and Lecture Room, of Railroad Y. M. C. A. They also make trips to Purdue School when they have a test on at the plant. The boys are taken there by the Assistant Superintendent of Motive Power or by the Superintendent of Motive Power of the road. This chance gives them technical instruction and also practical at the same time. They have a class of about 30 members. It was started for the betterment of the boys and the company. They hold their meetings each week.

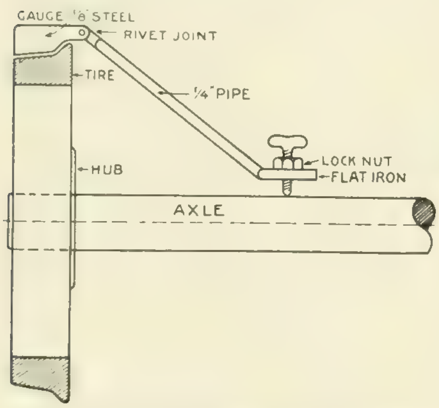
NORMAN BYRN.

New Albany, Ind.

Lateral Motion Gauge.

Editor:

Cut flanges may be prevented by the intelligent use of a gauge, of which I enclose a rough drawing. The gauge is furnished with an arm made of ¼-in. pipe which extends inwards towards



GAUGE FOR SIDE PLAY ADJUSTMENT.

the axle. The arm has a flat iron end, through which passes a thumb screw sharpened so as to scribe a line on the axle. A line scribed on the axle from both tires gives a mechanic the opportunity to measure the exact distances to the hubs of the wheels. We take off from each side half the amount to be allowed for lateral play. Flanges will cut unless they are equi-distant from the hubs.

All our engines run one way, they are never turned round, and hence in always hanging to the outside of the curves, which are numerous on the road and quite sharp, the tendency to cut the flanges is very great. By the careful use of this guage we have entirely prevented flange-cutting, and no trouble can ever arise in this way while the tires are kept laterally correct. The gauge has the double advantage of being very easy of construction and is in all cases very reliable.

A. J. MONFEE.

M. M., Birmingham Southern.

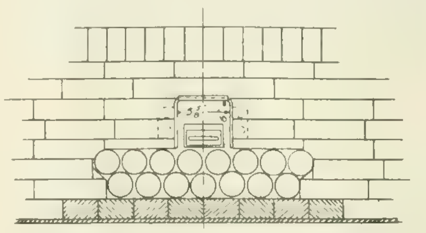
Pratt City, Ala.

Oil Burning on the Southern Pacific.

The use of crude petroleum as locomotive fuel has been in vogue for some time on the Southern Pacific and there has by careful and intelligent appreciation to details been evolved a system of oil burning which is giving the company every satisfaction. The furnace arrangement and the oil burner are separate features of the Southern Pacific practice. The general plan is shown in our illustration, Fig. 1. It is known as the Heintzelman-Camp furnace arrangement and is fully covered by letters patent.

The process by which the present system has been developed has been gradual and since the advent of fuel oil for use on locomotives and other furnaces the Southern Pacific have had considerable experience with different types of furnace equipment, and almost every known type of interior arrangement of brick work has been tried. This consisted of the arch, the double arch, walls and bridge walls, having a certain amount of batter and all in use with the burner placed at the rear end of firebox with flash hole through bottom of firepan. Experience in this direction has indicated that the fireboxes so fitted had too many fire brick, and there was not an equal distribution of heat to all parts of the box. The arrangement shown is practically the result of a good many experiments. This not only accomplishes the object of free and regular distribution of heat to all parts of the firebox, but has reduced the first cost of fitting up and the cost of maintenance by about 50 per cent. It also aids materially in the quick turning of engines at terminals.

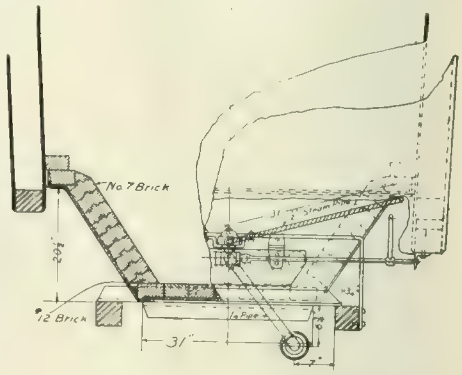
When repairs are needed on the interior of a firebox workmen are able to get at it in much less time than if the engine had been equipped with arch or bridge wall, as the operator has free access to all parts of the firebox without necessitating the removal of any of the brick work. The arrange-



BRICK ARRANGEMENT WITH BURNER.

ment has reduced the cost of boiler repairs to the minimum at all division points and has proved that a large mass of brick in a locomotive firebox tends to add to the expense of repairs, not only to the brickwork but to the boiler as well.

Writing on the subject of firebrick in a locomotive firebox, Mr. T. W. Heintzelman, superintendent of motive power of the Southern Pacific at Sacramento, Cal., says: "We all know that fire bricks are poor conductors of heat and even at white heat they do not convey heat rapidly to firebox sheets for steam making. We have taken the most refractory fire brick



END VIEW OF FIREBOX.

and found that it will melt in a comparatively short time, not only from the intense degree of heat produced by the oil fire, but from the fluxing agent introduced with the oil, especially salt or alkali-salt, with which most crude petroleums are associated. With this extreme condition it has been decided that bricks are poor conductors of heat. To further substantiate this I quote from the Naval Liquid Fuel Report made in 1904, the conclusions being derived from a test which covered a period uninterruptedly for twenty-eight months."

The report says: "The more experience the board had with arch construction the more convinced the members became that by reason of such construction being subjected to very severe heat and occasional chilling, practically but little endurance could be expected. Before settling, therefore, on any approved form of baffling arch the effort should be made to dispense entirely with any brickwork, except a lining for a portion of the furnace length and a simple vertical bridge wall whose height could be increased or diminished at comparatively trifling time, trouble and expense."

Acting on the results of their own experience, which was also in accord with the opinion expressed in the Naval Report, the officials of the Southern Pacific made further practical investigation in order, if possible, to further substantiate the claim that the least number of brick used the better. When engines came to the shop for new fireboxes, having previously been equipped with the arch and battered wall and flash hole, with burner at rear end of firebox, it was decided to use less firebrick in the firebox. These engines were equipped with the present arrangement for oil burning and placed in ser-

vice. These engines gave from 9 to 18 months further service.

Coal burning locomotives sent to shops for new fireboxes had some slight repairs done on the fireboxes, and they were equipped with this oil burning arrangement and gave from 6 to 18 months' further service. Many other cases of getting increased service out of fireboxes by the use of the Heintzelman-Camp oil burning arrangement are on record. This arrangement the railway officials believe to be superior to that of the arch, battered wall or any other form of brickwork arrangement. Instead of practically making a retort of a furnace by building brick walls and arches, they now use a free and open furnace, which by properly arranging the draft appliances, gives an equal distribution of heat, and this has resulted in an increase in the diameter of the exhaust nozzles, thus softening the blast upon the fire and serving to produce a much less distressing effect upon firebox and tubes. In some cases the increase in the size of exhaust nozzles has been from ¼ to ⅝ in.

The form of oil burner or atomizer used is a most important part of the equipment. The burner used on the Southern Pacific, shown in Fig. 2, has been patented by Mr. G. B. Von Boden, oil burning inspector, and Mr. E. F. Ingles, road foreman of engines, on that system, and from this device excellent service has been obtained with the firebox arrangement adopted on the road in which a minimum amount of fire brick is the prominent feature.

no delicate parts to get out of order or to prevent its free working. The waste of oil, or drip, is said to be practically eliminated with this form of burner.

In the operation of this oil burning arrangement the mixture of atomized oil and steam, which is delivered in a rearward direction from the discharge nozzle of the burner, passes above the

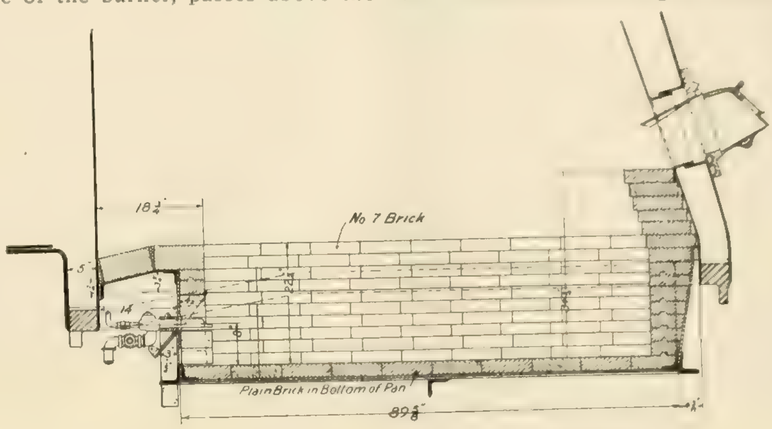


FIG. 1. SIDE VIEW OF FIREBOX ARRANGEMENT.

floor of the botton pan of the firebox, and above the air, which is drawn in through the draft openings, by the action of the exhaust. Air drawn through the tube holes, which serve as draft openings, moving in the opposite direction to the oil flame, tends to raise the flame in its rearward traverse. The flame meets the oppositely moving current of air from the upper air passage through the fire door and thereafter passes forward through the firebox, below the crown sheet to the tubes. In practice the oil is found to be con-

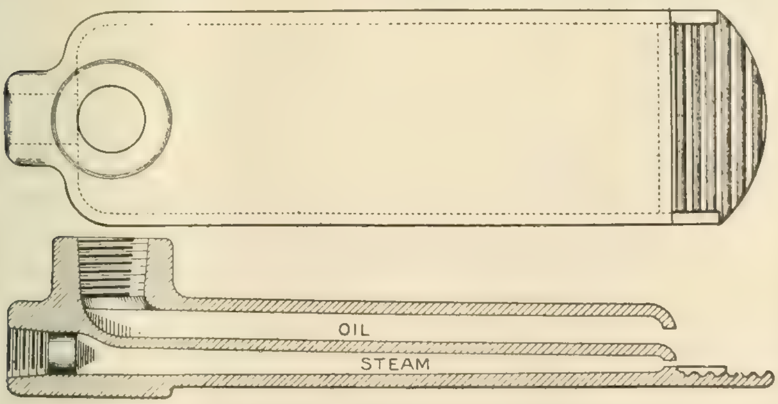


FIG. 2. VON BORDEN-INGLES OIL BURNER.

The particular feature of this oil burner consists of outside atomization, combining the fuel and vapor on, or above a corrugated lip projecting in front of the oil and steam discharge and below the latter, for the purpose of more thoroughly mixing the discharge and controlling its movement before passing into the fire.

The construction of this atomizer is exceedingly simple, the entire burner being cast in one piece, and there are

sumed inside the firebox with a very uniform application of heat to the surfaces thereof, and the flame produced, which is a light yellow, is soft and does not injure the crown sheet or tube sheet or cause leaky tubes. It may be added that the method of reducing the heat while the engine is standing is not only economical in practice, but is entirely free from the usual evil effects of rapidly cooling that occurs on opening furnace doors.

Opposed to Electrification.

One of the reasons given by a vice president of a steam railroad in the West against electrification of the lines entering Chicago is that conditions in that city are unlike those in New York, where the electric working of traffic has been carried out. He says, "It is well to remember that the railroads entering Manhattan Island from the north were forced to electrify chiefly because all trains for the Grand Central station are obliged to pass through a long, poorly ventilated tunnel, and, while it was possible to operate engines on such trains without smoke or at any rate without any considerable amount of black smoke, it was not possible to do away with all the noxious gases. A ride through the tunnel was unpleasant and often dangerous."

He also says that it would practically be impossible to electrify railroads in Chicago until track elevation has been completedö after that had been done the railroads would have hundreds of steam switching engines for which a substitution of electricity would be impossible, at least, until a self-contained motor shall have been discovered.

Stevens Institute.

The commencement exercises of the Stevens Institute of Technology, Hoboken, N. J., celebrated in the second week of June, were of more than usual interest. The degree of Mechanical Engineering was conferred on nearly one hundred graduates. The president of the Faculty, Alex. C. Humphreys, M. E., LL. D., made an eloquent introductory address, and Dr. Henry Pritchett, president of the Carnegie Foundation for the Advancement of Teaching, delivered an address to the graduating class. The attendance of visitors was very large, and the Institute buildings, which have lately been considerably added to, were opened for inspection. The Carnegie Laboratory of Engineering was the theme of universal admiration, the equipment embracing every description of steam, electric and gasolene engine and other machinery

The Path to Knowledge and Success.

By Angus Sinclair, Doc.Eng.

There is no royal road to learning is a true saying, but nevertheless there are roads much easier to travel than others. That line of reflection kept recurring to me while attending the Purdue University lately on noting the effective help the students receive at every step of their progress on the highway to skill and learning. To those who have labored through the ordeal, self help successfully followed towards fame and fortune is a source of some satisfaction, but most of the people who have risen above the common level by unaided toil would have gained a higher plane had they enjoyed the assistance that those educated in their line could have imparted during the struggling period.

Contrasts are said to be odious, but I could not help contrasting the lot of engineering students guided directly towards the goal of their ambition by professors pointing the proper way and guarding the mental travelers against straying or stumbling, with the lot of one who had to grope his way to an engineering education without help or direction.

When sixteen years old I went from my village home to the railway shops in Arbroath, a large manufacturing town, where I was telegraph clerk in the superintendent's office, apprentice and general utility boy. Life was remarkably dreary those days, for I was among strangers of the coarse manufacturing class, who cared for little beyond living as comfortably as their means would permit, with no ideals and no ambition beyond sordid desire for more pay. The desert of dreary toil was to me illuminated a little by my taste for reading and the privilege of a good public library.

Any influence which has inspired a boy to ambitious efforts ought to be worth mentioning to young men about to embark upon the careers of their choice. There was in Lawrencekirk, my native village, an organization called the Young Men's Mutual Improvement Society. All the intelligent boys of the village belonged to that society and the earliest manifestation of ambition was to acquire fluency as a debater or to be regarded as an authority on the topics selected for discussion. When I became settled in Arbroath I began to inquire about Young Men's Mutual Improvement Societies, and after a time found one bearing the more humble name of the Young Men's Debating Society. I joined that society and was at once assigned the duty of leading the debate on the question, "Was the Flood Universal?" The encyclopedia has been a very useful tool of mine and the Flood question first taught me to seek that aid to knowledge.

The young men belonging to this society were above the average in intelligence. They were youths striving to improve their minds. Questions relating to education frequently came up and mistakes in grammar were savagely assailed. There used to be a new debate every week and I got into the habit of looking in the encyclopedia for information on the subject. The practice increased my fund of general knowledge, but more important still, intercourse with ambitious young men first impressed me with the melancholy fact that I did not know anything about engineering science, the science on which success in my business depended. When I came to have a realizing sense of my dense ignorance in this respect I fell into a condition of temporary despair; but happening to read in some book that Thomas Newcomen, who had first built a practicable steam engine, was a working blacksmith, I took heart again and began searching for a teacher of applied mechanics.

The blunders, misconceptions and awkward mistakes that dominated my search after engineering education remind me strongly of a pedestrian tour I once took part in through the Highlands of Scotland. One day's experience will do for the whole. Three of us started bright and early up a shady glen with buoyant step and joyful hearts. When we had gone two hours on that direct journey, we came to three gillies who were out to prevent intruders from disturbing deer that gentlemen were out hunting. They informed us that we could go no further in that direction. In vain we protested that it was a people's highway. They did not care. Did we want to fight our way? We did not.

These Highland gillies or gamekeepers are a stalwart, vigorous class, who spend most of their time on the hills, many of them being trained athletes.

The story is told about one of these men being prostrated with an attack of pleurisy and the doctor gave the wife strict injunctions to apply leeches to her husband's side. When the doctor made a visit next day he remarked, "Mrs. Gordon, your man is decidedly better; I'm thinking you made good use of the leeches?". "Leeches!" exclaimed the woman, "I knew that worms widna help my Hugh, sae I put a ferrit to his side."

The only way open was to climb a mountain at right angles to our route. It took us two hours of hard climbing to reach the top with no road in sight. All afternoon we toiled along zig-zag sheep paths through quaking bogs, over shoe cutting morasses and by torrential streams that often blocked our course, and in one case had to be waded waist deep.

On making inquiries after a teacher who would impart for a consideration lessons in science, a superannuated dominie was strongly recommended. On being interviewed this man urged me to take lessons in navigation, which had become his specialty, but I could not see how the art of finding the location of a vessel on the ocean would aid me in mechanical calculations. The teacher's range of knowledge was limited, and after navigation was refused he proposed a course of study in Latin, holding that it would be useful to be able to give the Latin names of engines and their parts just as doctors had to give Latin names to their drugs. I failed to see the parallel between drugs and driving wheels. There was danger of our attempt at scientific study falling through, when one evening the old gentleman called at my lodgings and gleefully informed me that he had discovered what I needed. It was a course of study in moral philosophy. Philosophy was held by Plato, he said, to be the supreme and only true science, therefore no better training on the principles of engineering could be found.

The particular treatise recommended was Dugald Stewart's "Outlines of Moral Philosophy." I devoted my spare time for nearly two winters pondering over Stewart's abstruse reasoning, but I failed to see wherein the hair-splitting abstractions helped to throw light upon a single engineering problem. The labor was not absolutely lost, however, for it trained me into habits of mental concentration, but it was a circuitous route to reach a desired goal.

One day that I was doing work in the drawing office of the works I found a copy of Clark's Railway Machinery, which fascinated me as no book had previously done. That book ended my wrestlings with Dugald Stewart. The chief draftsman, who was owner of the book, gave me permission to read it whenever I had time to visit the office, but it must remain there. After reading the great work with zealous care I proceeded to copy the more important parts, an act of love's labor that filled my mind with sound principles concerning the locomotive engine, the proper forms of design, together with its economical management and operation.

Many years have passed since Clark's Railway Machinery was first the object of my adoration; but no other book ever attained the same place in my admiration. It has been the quarry from which many other engineering books have been indebted for their best material and it is still a safe reference for those who desire to learn sound principles of locomotive engineering.

For years Clark's book was the principal object of my study, but others came in course of time, principally works on natural philosophy. There ceased to be scarcity of material for study, but I always suffered from the lack of mental training that produces steady, persistent application.

Various forms of gamekeeper gillies intruded themselves on my path of self-instruction. Scotland furnishes many examples of workmen who have worked their way into the learned professions by persistent study and unaided labor. But there are exceptions. Study was not popular among workmen in my time, and it took no small amount of fortitude to withstand the ridicule, raillery and derision of one's associates. They were the gillies ready to turn aside ambitious individuals aspiring to rise above their class.

When a youth is moved by vague ambition to study for some ulterior benefit, he is almost certain to experience lapses of industry. I occasionally wearied of well doing and fell back into play or indulged in dissipations of novel reading. This would be succeeded by reactions towards industry. I attempted at one time to compel myself to study regularly one hour every evening, but it proved too much for one often fatigued by hard work. Then I fell back upon half an hour, which seemed too long, and I finally settled upon twenty minutes. That period of study I stuck to with decided persistency. A naturally obstinate disposiiton helped me in that practice and after it had been acquired as a habit nothing was allowed to interfere with my twenty minutes of study. The remembrance comes vividly to me of many times reaching home weak, sleepy and weary from many hours of hard work on an engine, then cleaning myself, with the book on the washstand, that necessary labor and study should be combined. Nodding, sometimes napping, but putting in the twenty minutes' task.

In thinking about my school masters as the influences that helped me to a fair education, I must not forget Willie Laurie, one of my most valuable instructors. Willie was a boilermaker, famous for his skill in tinkering cracked fire boxes, and in drying up leaky tubes. My first introduction to Willie was at the shop gate one meal time, when we were waiting for the bell to call us to labor. The men had been discussing the attractive subject of what each one liked best to drink. There were great diversities of taste expressed when some one became conscious that the views of an expert had been overlooked. Then the question was asked:

"What do you like best to drink, Willie, when you have your choice?"

"Weel," replied Willie Laurie, "when I hae my choice there is naething I like better than one glass o' whisky mixed with anither glass o' whisky."

A day or two after that I was assigned as tool carrier to that Willie Laurie, and we spent much time together in scorching fire boxes and in humid tenders. On the first day of my boilermaking duties we had worked several hours in one fire box, and after we went out Willie asked: "How many grate bars had that fire box?" I had not the least idea of how many bars there were, but he insisted on having me make a guess. It was far off from being correct and he made fun of my ignorance. That was the beginning only. Every day he had puzzling questions about boiler details and abused me for the wild guesses I made. Very soon I fell into the habit of counting the numbers of tubes and staybolts, measuring the dimensions of every part I could reach and taking careful notice of every detail. A habit was thus formed that became highly useful in my engineering career. It was the developing of the observing faculties, acquiring the power to see things. I ran locomotives about ten years and never had a failure on the road except broken springs and tires. The exemption from accidents was due to the ability to make a rapid inspection of the machinery, loose nuts and bolts never escaping my notice.

The training that Laurie gave me formed a valuable part of the capital that contributed to my success in life. The habits of observation combined with steady industry and the inclination towards study were the real friends that pushed me up the steep grade to the position of a successful engineering journalist.

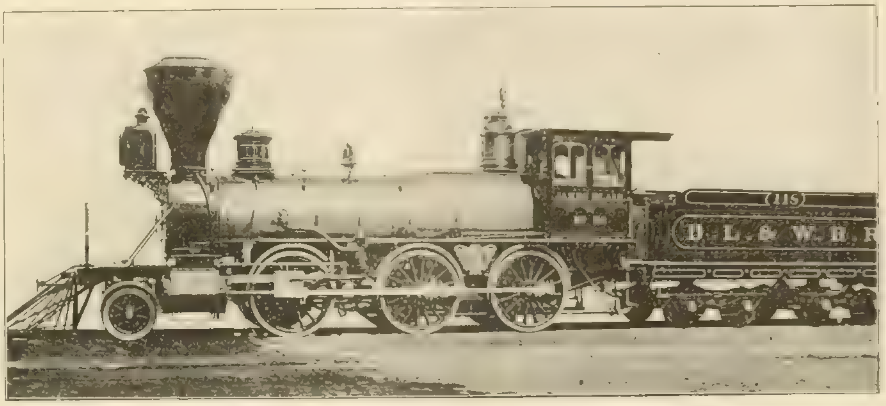
Engineering journalism is a field to which many have been called and few have been chosen. When I entered that field I had enjoyed the advantage of having previously done much work on general newspapers and magazine writing, yet I met with serious discouragements in the beginning of my experience as an editor of a technical journal. When a person passes from the shop, the cab, the drawing office, or the engineers' corps, to the editor's sanctum, he naturally draws upon his experience for articles, but the end of that source of supply is soon reached and unless the new candidate for steady employment has other sources of mental and professional capital his career at the editor's desk is soon ended.

When I first joined the editorial staff of a weekly mechanical paper I worked industriously on notes of my experience, and at the end of three months I found my sources of supply "pumped dry," as some noted failures expressed the harassing condition. I confessed my dilemma to a fellow editor, and he said, "Nonsense, you have stuck too close to the office; go out and visit workshops, it does not matter what kind." I took the advice and in the course of a day's ramble saw so many things to write about that I never was pumped dry again.

This experience taught me that the secret of enduring technical journalism is study and observation. This hint may be useful to others who are ambitious to become technical newspaper men.

The men who have risen from the lower grades of the mechanical department of railways to be master mechanics, superintendents, managers and presidents, have displayed characteristics that commended them for advancement. The most valuable attribute a workman can possess is a thorough acquaintance with every detail of his business. Very little credit is due for being a good operative engineer or good workman, for every one worth employing tries to be a good hand. High credit is due to the man who acquires thorough acquaintance with the science of his business, a man who has knowledge to sell to his employers, besides ordinary ability to perform a fair day's labor. Such men are in demand to-day, and it pays to devote leisure hours to study and to developing habits of observation.

The book engineer and the scientific mechanic have enemies and detractors on every railway in the country, detractors noted for nothing but dense ignorance and mistaken notions, that always keep them frozen to the lowest of inferior positions. The ambitious youth may secure promotion by deserving it, but the obstacles to be overcome can only be accomplished by the intelligent and active exercise of self-help and well directed study.



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The Heroic in Railroading.

The heroic in battle has been the theme of poets in all ages, as if the mere killing of our enemies was the noblest thing imaginable. If war could be stripped of its spectacular elements and revealed in its bare brutality, it would be a poor subject for song or story. That the noblest attribute of humanity—self sacrifice—may be called into action in battle is undeniable, but it is rarely the dominant factor. It is in the hope, wise or otherwise, that our antagonist be made to bite the dust that we rush on to death or victory.

The humble, and often unrecorded, acts of heroic adventure, where one risks one's own life to save another, perhaps unknown, fellow creature, reveals an impulse infinitely nobler than the mere grappling in a struggle to the death with foemen. Perhaps in no realm of human endeavor is there more exalted heroism displayed than in the many instances of railroad men, at their own peril, rescuing the lives of others who are in jeopardy. The Interstate Commerce Commission have, by request of the President, arranged to award special medals for life saving on railroads and have established a system of collecting satisfactory evidence in each particular case. The report recently published shows a number of cases of absorbing interest as illustrating the heroic in the moving accidents that occur in the life of the railroad man. In every instance the noble impulse of self sacrifice is evident. The case of George H. Poell, Grand Island, Nebraska, is a case in point. He was a fireman on the St. Joseph & Grand Island Railway, and saved the life of a three-year-old boy by going out on the pilot of his engine and picking up the child from the middle of the track while the train was moving at the rate of about twelve miles per hour. The child escaped injury, but Mr. Poell's arms were broken and his left foot was so badly injured as to make amputation necessary.

The news of this heroic act with its attendant disaster was widely known among railroad men, but Poell's misfortune did not prevent Edward Murray, Pittsburg, Pa., a freight conductor on the Pennsylvania Railroad, from risking his life under nearly similar conditions. While a locomotive and tender were backing up in switching operations, two children stepped on the track a few yards ahead of the rapidly moving train. Mr. Murray leaped from his position on the tender, lifted one child clear of the rails and grasped the other in his arms just in time to step on the footboard of the tender as it came up. No one was injured.

Charles W. Haight, Utica, N. Y., an engineer on the Delaware, Lackawanna & Western Railroad, also saved the life of a young girl by running out to the pilot of his engine and picking her up from the track in front of the moving train, both escaping injury. George H. Williams, Braintree, Mass., an engineer on the New York, New Haven & Hartford Railroad, was less fortunate as far as he himself was concerned. While preventing a lady from a rash attempt to cross the railroad track in front of a rapidly moving train, near where his engine was standing. He managed to save the lady from injury, but was struck by the engine himself necessitating his removal to a hospital for about three months. A similar incident occurred to Edward A. McGrath, station agent at Stowell Station, on the Chicago, Milwaukee & St. Paul Railroad, at Milwaukee. A girl of six years, crossing the track in front of an approaching train, and heedless of the warnings shouted to her, would certainly have been killed but for the heroic act of Mr. McGrath, who rushed to the child and picked her up, but was himself struck down by the pilot beam of the engine though not seriously injured.

Other acts equally heroic are included in the report, and we have selected these merely as illustrative of the readiness with which railroad men risk their lives in the saving of others. The ribbons, rosettes and bronze medals of honor are fitting and proper as far as they go, but we are hopeful that Congress may eventually empower the Commission to make more suitable rewards to those who may be permanently disabled by reason of extreme daring in endeavoring to save lives. The Railroad Companies generally act very liberally towards their employees in such cases, but it must be remembered that it is a public duty to reward in a public way, acts of the kind that we have described, and not leave the reward to the caprice of corporations whose means are in many instances, especially in times like the present, extremely limited.

Daylight Saving.

The railways of the United States and Canada are run on what is known as standard time. There are five divisions of the continent of North America corresponding to the 60th, 75th, 90th, 105th and the 120th meridians which give us Atlantic, Eastern, Central, Mountain and Pacific standard time. These meridians are all 15 degrees apart. At the equator each division corresponds to something over 1,100 miles.

In the British Isles the time for the whole country is that of Greenwich, and there is a proposal now on foot to pass a bill in Parliament to "save the daylight." The matter is now being considered by a committee of the House of Commons, and if the bill becomes law it will officially or legally alter the clocks in the United Kingdom, and thus railway time will undergo a change along with everything else. The plan is put forward by Mr. William Willett, is that the hour between two o'clock and three o'clock in the morning of each of the first four Sundays in April of each year shall be a short hour, consisting of forty minutes only, and that between two o'clock and three o'clock in the morning of each of the first four Sundays in September shall be a long hour, consisting of eighty minutes. The plan now proposed will not even cause any alteration in ordinary railway time tables, for the station clocks would be regulated between 2 A. M. and 3 A. M. on Sundays in April at a time of infinitsimal traffic.

The object of this is to save the light as one may say, and a longer period of daylight after business hours will be enjoyed by the working people. The railway time tables will not be altered and schedules will not be disturbed; only everybody will get up three-quarters of an hour earlier and stop work that much before the usual time. The practical effect will be that the evening will appear

to have a little more daylight than it has now.

A number of representative people have given evidence before the parliamentary committee in favor of the Daylight Saving bill, as it is called. Sir George Livesey, chairman of the South Metropolitan Gas Co., in London, thought the gas companies would lose about £380,000 by the change. The general manager of the Great Central Railway approved of the bill, but suggested an alteration of the even hour instead of 40 minutes, to begin the third week of April and end in the autumn. The representatives of the London and North Western Railway also approved the bill.

Sir Robert Ball, the professor of astronomy and Geometry, from his observatory at Cambridge, says in reference to this proposal: "Which is the better for our waking hours, glorious sunshine, which costs us nothing, or expensive and incomparably less efficient artificial light?" Only perverted habits could make us hesitate as to the answer to this question. The admirable "scheme of Mr. Willett will rescue 210 hours of our waking life from the gloom of man's puny efforts at illumination, and substitute for it—sunbeams. There are no difficulties connected with the scheme which could weigh for a moment against the advantages of its adoption."

Many places in this country have almost as much difference in the time they observe as would be effected by the Daylight Saving bill. The city of Detroit now maintains its own local time, which is 28 minutes slower than Eastern standard time and 32 minutes faster than Central standard time. Trains going east out of Detroit are run on Eastern time and those going west use Central time. Railway employees at Detroit working on Eastern standard time have practically the advantage of the daylight saving system during the summer, while in the winter the advantage is with those using Central standard time, as in the morning the period of darkness is shortened.

Compensation for Injuries.

The politicians who are tumult leaders in the United States have been laboring in season and out of season to convince railroad companies that their interests will suffer severely, should laws be passed by Congress embodying the principle that the laborer should be indemnified for injuries received in the course of his employment. The impression is disseminated that the movement in favor of treating workmen fairly emanates from a socialistic spirit that ought to be suppressed instead of being encouraged by concessions. We are given to boasting that the United States takes the lead enacting laws promoting liberty and for the comfort of the masses; but democratic as we are, the welfare of the people at large receives less consideration from our law makers than the toiling population of other countries receive from their law makers.

Take the case of compensation to laborers for injuries received in the course of his employment. Laws have been passed in twenty different countries calling for the awarding of damages for injuries. Even Russian law provides that in case of death, dependent heirs shall receive a pension not exceeding two-thirds the annual wages of deceased. In most countries the compensation consists of medical treatment, periodical payments for temporary disability and pensions or agreed upon sums for total disability or death.

When the employers of labor in foreign countries are willing to compensate their employees for accidents received in that service, it appears to be promoting rank injustice to influence American employers of labor from doing likewise. The fellow servants' law, the greatest iniquity inherited by this country, has been practically abolished in the land of its birth, but our unjust employers cherish it as an excuse for taking advantage of unfortunates.

Care of Locomotive Boilers.

At the convention of the International Boiler Makers' Association, recently held at Detroit, Mr. E. W. Rogers, of the American Locomotive Company, at Paterson, N. J., in presenting a report on the care of locomotive flues, spoke in favor of wide copper ferules. He urged the treatment of water in bad water districts and referred to the necessity of careful handling of engines on ash pits.

Mr. F. M. Whyte, mechanical engineer of the New York Central Lines, thought it would not be practicable for any man to say which is the best method of setting tubes, because what would be satisfactory in one part of the country would not be practicable in another. Mr. Whyte suggested that the association print in their proceedings a description of all the various methods used and under what conditions the work was done, with the results obtained.

Mr. J. T. Goodwin, of the American Locomotive Works, at Richmond, Va., presented the report of a special committee on "Boiler Explosions, Their Cause and Remedy," his associates being Messrs. T. C. Best, J. Kelly, H. L. Wratten, J. A. Doarnburger and C. L. Hempel. The report includes a valuable compilation of data covering all kinds of boiler explosions from 1879 to 1907, their cause and number of people killed and injured. The total number of locomotive explosions from all causes during the past 10 years was 232. On the question of remedy and preventives the committee said that the proper safeguards against this form of disaster were conscientiousness, intelligence, correct design, the employment of reliable and experienced makers, capable men in charge of construction, periodical inspection, prompt repairs, and the removal of boilers before deterioration sets in.

Mr. Garland P. Robinson, of the New York State Public Service Commission, Second District, spoke of the rules of the commission, which apply to 6,000 locomotives. In the past year, of 17 accidents reported, only three were explosions of locomotive boilers. Accidents and fatalities occurring during the past year, he said, were due more to minor causes than anything else. The few explosions that occurred were due chiefly to low water, and Mr. Robinson expressed the opinion that sufficient care is not given to water glasses and gauge cocks, especially in the matter of keeping them clean.

Draw Filing.

Fine finishing was a marked feature of locomotive work for many years and it still prevails to a great extent in marine engines. The milling and polishing machines now in general use are deemed sufficient for ordinary purposes, but there is a degree of fineness in hand work that no kind of machinery can equal. On the locomotive this is especially noticeable on the guides and connecting rods where the fine finishing of the skilled mechanic gives an appearance of elegant perfection that is peculiarly pleasing to the eye of the keen observer.

There is a glitter or gloss about machine finishing that is unapproached by hand work. Samples of this kind of finishing are to be seen in its highest degree of perfection on the automobiles made in France. The buffing wheels must be very fine in the machine shops there, or what is more likely as the wages are small, there is no such hurry about the work as there is in the general contract factories in America. This glossy finish, however, does not conceal the fact that the surfaces may be defective in the important element of straightness which is the crowning feature of finely finished hand work.

There is no substitute for draw filing in producing the straight finish, and while there is not the demand for draw-filed finishing that there was years ago, it is still an important accomplishment in a locomotive machinist, for when this kind of work is required it has to be of the finest quality.

As is generally known, it implies the use of the smooth file in a direction at right angles to the length of the work. The best work can be done when the file handle is removed, and by grasping

the flat of the file in both hands the action of the file can be better controlled than in cross filing. When carefully used the file produces an accurate surface with the grain of the finish in the direction of the strokes.

In general practice nearly all surfaces that are finished are machined smooth to a correct size so that as little as possible should be removed by the file. It is good practice to apply emery cloth crosswise on the surface while the process of draw filing is going on. The action of the emery cloth, which may be wrapped around a parallel piece of wood, reveals the scratches which are unavoidable in draw filing, but which can be readily lessened by the intelligent use of the file. The finishing strokes should be given with fine emery and oil, and when a piece of clean leather is wrapped around the file and charged with washed emery and oil, it will be found to give finer results than emery cloth which is not always free from imperfections.

The Battle of the Gauges.

The restrictions which the Interstate Commerce Commission and other semi-political bodies are imposing on the railroads in our own day, recall the early acts of the Parliamentary Committees emanating from the British House of Commons, and which tended to greatly hinder the introduction of the steam railways. Probably the most absurd of these commissions was the one appointed to settle the question of the distance between the rails on railways. This battle of the gauges was brought about by a class of men who seem to emanate from all legislatures in all countries. Blind mouths, as Milton called some of the parasites in his day, men who did not care to grapple earnestly with any question, but who were content to let the people who represented varying opinions rend themselves to pieces as much as they pleased so long as they themselves sat in comfort and drew their exhorbitant salaries. The endless committees and Parliamentary camp followers threatened to absorb all the railway capital in the country. Expert opinions offered by men like Stephenson and Brunel were held to be of no value. The Legislature preferred to keep the question open. It has been frequently asserted that the battle of the gauges cost more than the campaign that culminated in the battle of Waterloo.

The saddest part of the story is that the people eventually pay for all this nonsense. The result leads to over-capitalization, which is followed by high charges and the succession of what then comes to be unavoidable iniquities. These are visited upon the children of those who permit such high-handed rascality. The railway gauge was a question not easy of solution. Of all men calculated to settle such a question, the political camp follower was the least fitted. Engineering questions require engineering experts, and the world is never wanting in the right men for the right place if those high in authority have the clear vision to look for them.

General Foremen's Association.

The annual convention of the International Railway General Foremen's Association was held in Chicago the last part of May and it was a very successful affair. A number of excellent reports were presented, and the association shows gratifying evidence of progress in various ways. We reprint in another part of this paper a number of the reports, and the rest will follow later.

This association has just been in existence four years and it has accomplished much; nevertheless there is in the president's address insistence upon that very obvious truth that it is by the exertion of individual members of the association that the ultimate success of the organization must come. Everyone who enrolls himself upon the books of the association has a distinct and definite duty to perform in order to further the work in hand. Each member must take an active interest in all that is done. It is not merely the lending of one's name to the association or of quietly paying one's dues, though that is necessarily important. Each member must make the results of his daily work and life in the railroad shop a part of the association's proceedings.

A good suggestion was made to the Master Boiler Makers at their recent convention, and that was that the various methods of doing a certain piece of work, flue setting, for example, should be described and illustrated and embodied in a committee report and so find its way into the proceedings of the association. This same method might apply to the General Firemen's Association. Some standard piece of work in locomotive repairs such as frame welding or driving wheel turning or anyone of the many important operations which all railroad shops perform, might be described fully by the various foremen who are known to have made a specialty of that piece of work, and such a report containing perhaps two or three separate descriptions of different methods would form a record of performance from which instructive comparisons could be drawn and departures made as occasion might demand.

The many excellent papers presented show that there is a large amount of thoughtful work being done by the association, and the fact that so much time and labor have been put upon this work is evidence of a live and progressive sentiment in the association of which the members may feel justly proud. The attendance at the convention was good, and the interchange of practical ideas was beneficial to all. This is a feature of the greatest importance, and the time will come when railroad companies will not only permit their foremen to attend but will send them to the meetings. The convention is an educational exhibit.

Shop System and Control.

A right shop system can be made to give the means of control. The great bugaboo in the mind of the practical man when system is mentioned is its cost in clerical labor. These remarks were made by Mr. B. A. Franklin, of Boston, in a paper recently read before the New England Railroad Club, on "Shop System as a Means of Control." He referred to the right shop system as the one which brings to the practical man, regularly, comparatively and accurately, the facts of shop progress. The right shop system must also present its facts as to suggest means of improvement to the practical man.

The facts presented must not be looked upon as merely figures, but as points of view, or as pictures of shop occurrences. There are three elements in the shop. Material that becomes part of the finished product. Productive labor, that is actually engaged in work on the finished product. Factory expense, or the money spent on making effective the productive labor. The central element is productive labor and it is round this that the whole shop practice is built. There are two methods of handling labor, the piece work and the day work systems. Piece work if handled rightly is the best. Mr. Franklin was careful to point out that a great mistake many employers have made on piece work is to establish an irritating policy of rate cutting, so that the workman is afraid to work at his best speed. This is because the employer looks at the labor cost and not at his expense cost. It often pays to have a higher labor cost, if it will push out production, because under these conditions the expense cost, with increased production, may go down faster than the labor cost goes up.

Gang piece work, where the members are paid percentage of the set price, the foreman getting the larger share, is a good system and it produces co-operation between the members of the gang and increases the output above the individual rate. There is also piece work based on quality. If the quality of work is up to a certain standard the rate is paid. If the quality is bettered the rate per hundred on all done is increased. If the quality is lower than the standard, the rate per hundred on all done is decreased. The men soon learn that carefulness pays them. Piece work should carry with it the penalty for bad work. Quality is a matter of insistence.

General Foremen's Association

The fourth annual convention of the International Railway General Foremen's Association was held at the Hotel Lexington, Chicago, Ill., May 25-29, 1908. President E. F. Fay, of Cheyenne, Wyo., called the convention to order at 2 o'clock P. M., and addressed the meeting as follows: Gentlemen, Members of the International Railway General Foremen's Association and Guests: We have now assembled for the fourth annual convention of this association formed in St. Louis during the month of October, 1905. The object of the association is the dissemination of information relative to methods in vogue in the various railway shops in the United States, Canada and Mexico. Unfortunately, our membership, while large, has not been evidenced by the attendance at our conventions. We trust that time will remedy this state of affairs, and that the Superintendent of Motive Power of the various railways will recognize our worth to the extent of insisting on the attendance of those foremen who are eligible to membership, with all expenses paid by their respective railroads. In the discussion of the past three conventions there have been brought out many valuable and instructive points which have benefited every individual member. I am sure that we have reason to believe that this may be said of all future conventions. Certain it is that the members of this association are closer to the actual conditions both in the roundhouse and the back shop than any one else can be. It is their function to exercise a close, general or immediate supervision over all departments of modern railway plants. This being the case, it is reasonable to suppose that they will have ideas of immense benefit to their superiors, and it has been conclusively demonstrated that they do have.

In my mind there is no question but that this association is a step in the right direction and with immense educational possibilities. I bespeak for it a long and prosperous life. In conducting its affairs during the year just passed, I have received the cordial co-operation and the hearty support of its officers and members, and we have worked out an elaborate and instructive programme for discussion. I am confident that every member has taken the same interest in the welfare of the organization as have its officers. We have, unfortunately, been handicapped to a slight extent by the arrearages of many of our members, a condition which I hope to see corrected at this convention.

The business of organizations of this character cannot be satisfactorily transacted unless each member shoulders his part of the financial burden, which in any event is not burdensome. I would, therefore, at this time request that all delinquent members take care of their financial obligations to the association. I am advised that the entertainment committee has arranged for a very nice programme for our entertainment while here. I have also arranged for several well-known railway officials to address us at this time. There is no question but that these addresses will be both entertaining and instructive. I would also request that the members of the association be as prompt as it is possible for them to be in attending the various meetings which will be held, as the absence of a few of our members retards the progress of our meetings.

With these few remarks and trusting that the efforts of your officers during the past year in behalf of the association have merited your approval, and thanking you very much for your consideration, the business of the association for which we have assembled at this time will now proceed.

MR. J. F. DEVOY, MECH. ENG., C. M. & ST. P., SPEAKS.

Gentlemen of this convention: I want to say to you, and say with all candor, that I felt honored that you asked me to come down here and talk to you. One of my greatest ambitions in life was that I might sometime be a general foreman. I have passed through the different stages to a general foreman and they would not have any more of me. So one of the things of my life was lost. But coming down on the train this morning I picked up a newspaper and it led me to think of the necessity of your meeting here.

If I should start in and tell you that you should use treating tanks for your boilers or that you should use soda ash, I do not know but that I might get a long way from the subject, but if any one of you should decide and determine one thing in regard to the operation of a railroad you will have fulfilled your mission to Chicago and you will have done the world some good. Everyone of you will go back home and think that you have been a benefit to society and you will be a benefit to society if you have accomplished or directed how any matter should be done.

Friday morning I received a little book called Betterment Briefs, written by Mr. Jacobs, of the Santa Fe, who understands shop practice better than I do. I show you this illustration for machinery, a wedge in which seven different sides are milled at a time. In the same book on page fourteen, I show you a method in which they are placed in jigs and planed that way. There will be a difference between you and some of your colleagues as to which method should have been employed and why. One man perhaps hasn't a planer of the proper speed to do the work possibly as fast as the gentleman from the Big Four or some other road. But it is up to you to dictate to us the way that it shall be done, and how you can do it for the least amount of money. That is the whole thing in railroading. Let me emphasize more fully what I mean. On my way down, I happened to run across some store keepers and one of them says, "I hope you will tell the general foreman that we are all poor, and how I fooled you on four hundred driving springs." There were four hundred driving springs on the St. Paul some with holes between the spring, known by the different letters which designated their class. I said you better take a hammer and pin out the break. I will get a print and tell you the nearest engine that will take that spring, and we got rid of the whole lot of springs in thirty days. It is up to you to say whether certain material or certain methods shall be followed.

To illustrate more fully what I mean: It has been my privilege during the past year to be appointed on a committee of the Master Mechanics' Association to determine the size and the shape of the castellated nuts. When we started to do that there wasn't a man on the committee or a man on any railroad who maintained that they should be done in any way other than with milled slots. I did not believe that it was the proper thing to do and I want to say that now that nut is dropped from the forging machine in one operation. The credit for that belongs to the general foreman of the machine and blacksmith department of the St. Paul Railroad. He didn't do it in a day and you won't do it in a day. If you accomplish anything, it is up to you to get recognition, and you can do it if you want to. Here is where you should put it forward and tell what you have done.

The State of New York in operating its bridges over the Erie Canal was operating a large bridge by screw power twenty years ago. I passed over that bridge one day, and in going up and down, as you all know, there is so much spring to it, that I went back to the West Albany

shops and there asked the general foreman if we could not apply the air lift to it. That method is lifting the bridge to-day and it was a railroad general foreman that did it, and he did it after the experts of the State of New York had spent $85,000 monthly.

The first air pump that I ever saw was one developed by the general foreman of the West Shore Railroad. It was a simple affair with a main rod on top and two inlet valves on either end. The first time that I ever saw an engine successfully handled to determine what the pump was doing, was done by a gentleman here who is second to none, Mr. Sinclair, and I take pleasure to-day in thanking him for the manner in which it was done at that time.

I have worked piece work. When I left Cornell University, I went down to Syracuse to work. I was a pretty healthy specimen at that time, and there was a pretty good machinist by the name of Bill Maher. He put me grinding rods to straighten them. I knew just about as much about grinding rods as a duck would. He called me everything and I felt pretty sore, but I was a hustler. A little afterward he said they had a thirty horsepower frame and would see what I could do with that. Boys, he got me right where I lived, because at that time I didn't know anything that was loose that I couldn't lift. I took hold of the cylinder and I said: "Now, will you show me how to grind that rod?" But he wouldn't show me. That night we settled it in the old-fashioned way with fists, and I want to tell you I did not come out first, but Bill did not work the next day. I have to thank Bill Maher, for within two weeks I knew how to grind the rods.

There are men with whom I absolutely refuse to take issue, because they are too big for me, but I am going to say how to do the work if I know how, and if they do not listen to me I will turn my guns at a different angle. If I am put out one door, I will go in another.

ANGUS SINCLAIR'S ADDRESS.

Mr. President and Members of the Convention: I feel very much flattered that you invited me to address you, but I am afraid it is out of my power to tell you much about how you ought to do your work for the reason that I think you are the most technical of the various organizations of railways, and that those who can dictate to general foremen about their best methods need to have gone thoroughly through the mill, which I have not done. I have never been a general foreman, but have had a great deal to do with the general foreman and have very strong impressions about the importance of having efficient general foremen, but I should not like to undertake to perform the duties myself.

In regard, however, to the organization of this association and the work that is left for it to do, I have seen for a number of years that something of the kind had to come in the near future. I have been a member of the Railway Master Mechanics' Association for twenty-five years and I was secretary of it for ten years, consequently I have been in very close relations with the work which that organization is doing. Moreover, as a railway journalist, it is necessary for me to study the work done by the master mechanics and master car builders in the past and I found that while at first these organizations were performing the details which general foremen do now, they gradually wore away from that until their work was more general. It was specific, and consequently the work that used to be done by the master mechanic and was reported on by them and investigated by them was left to general foremen, and the result is nowadays, when the Master Mechanics' Association or the Master Car Builders' Association give reports on shop details they are copying or reproducing what has been performed for them by their various foremen. It naturally came that the foremen started an association so that they could talk intimately among themselves of what they were doing, and their efforts on behalf of improving methods will be much more satisfactory than it would be working through the line of their superior officers.

A tendency in that way began to come when the traveling engineers' association was formed. They were doing work which had previously been done by master mechanics, but the time came when it was necessary for them to attend specifically to the work they were doing, and do it independently of the master mechanics. It was waste of effort for them to report through the master mechanics; consequently the Traveling Engineers' Association was formed and has been very successful.

The same may be said in regard to Air Brake Men's Associations. That was another off-shoot that has been proven very successful, and has been highly beneficial to the railroads and the men engaged in that occupation.

The shop foremen, or general foremen as you call yourselves (I should think shop foremen would be a better name and would comprise a fuller class than general foremen). That is no business of mine, but I think if you would take in all shop foremen you would have a better field and could work to better advantage in getting in new members. This association has been in existence for four years and has grown very rapidly, but it has not grown as rapidly as the Traveling Engineers' or the Air Brake Mens' Association. And I think that probably comes from your members not being sufficiently impressed with the fact that it is the duty of each individual to be a committee on advertising for the association—a committee of one to bring in as many others as he possibly can. The strength of the association would be greatly increased if that was done, and the greater your membership is the greater will be your influence. And when you get it properly impressed upon the motive power officials that you are doing work which they ought to save themselves from meddling with, then you will be encouraged to go on in the way that you have started and your organiaztion will be increased. **(Applause.)**

PRESIDENT FAY: On behalf of the members of the association I thank Mr. Sinclair very much for the address and the ideas he has given us.

The first topic on the list of the general Foremen's Convention was the pounding of the left main driving box more than the right. The causes and how this pounding came to be avoided. The report is in the form of three separate statements by the case of Messrs. C. H. Voges, E. R. Berry and W. H. Kindeigh.

TOPIC NO. I.

Mr. President and Gentlemen:

I think I have a serious topic to discuss. This refers to high speed engines only.

We all know that both sides of the engine should be equal in weight and action, that is, the reciprocating parts should correspond with the counter balance of the driving wheels. All engines of to-day have the right side of the engine for the lead. When an engine is turned out of the back shop and properly broken in and turned over to the roundhouse foreman for service, we leave the wedges down enough so the boxes are free between the shoes and wedges' face. Now, when the engine takes the regular run in passenger service the engineer in charge must take good care and keep these wedges up in their proper place at all times. If he neglects to do this it will give the box a chance to start pounding on journal.

We all know the engineer's position is on the right side of the engine and naturally he would detect anything quicker in the running gears on the right side than he would on the left.

Now, if the engine is taken good care of by the engineer and the wedges set up properly, why should the left main box pound sooner than the right one? I have never given this a thoughtful study until the last three or four years, or have never noticed it so much since we have these large, high-speed passenger engines.

Probably when the left side follows the

(*Continued on page* 306.)

Applied Science Department

Elements of Physical Science.

XV.—ACOUSTICS.

Acoustics is the science that treats of sound. The vibrations of elastic bodies produce what is known to us as sound, the vibrations being transmitted through the air or other medium. All sounds can be traced to mechanical action, and are caused by shocks which are sufficiently strong to put the molecules of the sounding body in vibration. The movement of the particles of matter have the effect of stirring the air in what are called waves similar to the ripples in water when a stone or other body is thrown into the water. These proceed outward from the center of disturbance and gradually become less in volume until they are at last imperceptible. A bell struck in a perfect vacuum is not heard, the vibrations of the metal having no means of transmission to the atmosphere.

It is a fact that the approach of a railway train can be more readily detected by placing one's ear at the rail. Solid substances are better conductors of sound that the air, and liquids also conduct sound a greater distance than the atmosphere does, which is variable in its qualities as a conductor of sound. Denser air conveys sound further than the lighter air. This will be found to be so when speaking on the top of a high mountain where the atmosphere is rare. As cold increases the density of the air, it becomes a better conductor of sound than warm air.

Under ordinary conditions sound passes through the air at a velocity of 1,120 feet per second, or a mile in 4¾ seconds. Sound passes much more rapidly through water, the ratio being over four times greater in velocity, while iron transmits sound ten times more rapidly than through the atmosphere. Some kinds of wood transmit sound even more rapidly than iron. The extreme distance to which sound will travel in the open air has been variably estimated, the farthest audible recognition of the human voice being given as twelve miles. This seems incredible in view of the fact that the clearest and loudest speaking in the open air cannot be distinctly heard over ⅛ of a mile. It is said, on excellent authority, that the call of the sentinels at the rock of Gibraltar can be heard in Africa over twelve miles distant.

Sound is capable of reflection, and resembles light and heat in this peculiarity that the angle of reflection is always equal to the angle of incidence. A sound is sometimes repeated more than once, according to the number of reflecting surfaces on which it strikes. Sound reflected back is called echo. There are many remarkable echoes in the Alps and also in the Rocky Mountains, where as many as twenty syllables will be repeated, and others where a single word will be repeated thirty times.

Musical sounds, so called on account of their clearness and regularity, are produced by regular vibrations, that is, a certain definite number in a definite period of time. For instance: The middle C of the piano is produced by 256 vibrations a second, and may be said to have three characteristics—loudness, pitch and quality. Loudness depends on the amplitude of the vibrations producing it, pitch on the rapidity of the vibrations, and quality on the nature of the overtones peculiar to the body from which the sound emanates. Musical notes are said to be in unison when the vibrations that produce them are equal in time. The slowest vibrations that produce audible sounds follow each other at the rate of sixteen in a second of time, and a very low note is the result. As the vibrations become more rapid the pitch rises until twenty-four thousand vibrations may be reached when a very high note is produced, beyond which they no longer affect an ordinary ear as sound.

Speed Alters Tone of Bell.

The tone of a locomotive bell which necessarily gives out a certain definite sound, is, to those who hear it on the train passes, a different note to that which reaches the occupants of the coaches, and the speed of the moving train is responsible for this curious discrepancy in the sound. It may even run down several descending semitones on the musical scale. It would indeed be a wonderfully interesting sight, could we but see the waves of sound as they traverse the atmosphere around us, as they surge among, over and around the islands in that ocean of air in which we live. The sound waves beat upon the various objects which lie in their way, and are broken, reflected or turned aside like breakers on a rock-bound coast.

When a bell is struck by the hammer, caught on the swiftly up-swung rim, the whole sound-bow of the bell vibrates briskly and gives out a clear, strong tone. The shiver of the sonorous metal is communicated to the air as a series of pulsations which cause the elastic atmosphere around the bell to become alternately dense and rare, and each rhythmic ebb and flow is what we call a wave of sound.

These rhythmic vibrations given off from a swinging bell are so rapid that

BIRD'S-EYE VIEW OF THE RAILWAY TUBULAR BRIDGE, THE CARRIAGE SUSPENSION BRIDGE AND THE FOOT BRIDGE AT CONWAY CASTLE.

each sound wave moves but a short distance when it is followed by another and another and another. If a bell has the shape and size necessary to produce 256 separate pulsations of the air in one second, the sound it gives out is the musical note corresponding to the middle C of the piano. It must be remembered that the whole of the 256 vibrations in the second, are all produced by a single stroke of the hammer on the rim or sound-bow of the bell. In tranquil air, these 256 sound waves pass outward in all directions at a speed of about 1,120 feet a second. For this musical note, called middle C, the waves of sound are therefore each about 4 1/3 ft. long. In one second of time, the drum of the ear is thus made to vibrate 256 times in unison with these sonorous waves, when we hear this definite and well-known musical tone.

A bell tuned to the middle C, when struck once, pours upon the air a series of sound waves each 4 1/3 feet long and as many as 256 of them to the second. Such a bell rung steadily on a locomotive moving at high speed does all this, but the swift pace of the engine modifies the sound waves before they reach the ear of a man standing beside the track. An engine going a mile a minute rushes over the rails at the rate of 88 ft. each second. The first vibration flung from the bell traverses 4 1/3 ft. in the air, while the bell vibrating with the second wave is carried forward something over four inches. The wave lengths are therefore shortened ahead of the engine and consequently there are more of them launched into the space in front. A sharper tone thus reaches the ears of those who stand beside the track ahead and hear.

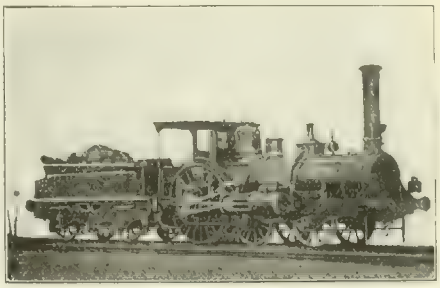
The sound waves flying off behind the bell are lengthened, for although the first of the back-thrown waves traverses its 1120 ft. in the second, the the last of them has come from the bell now 88 ft. further down the road. The re-spacing of the wave crests which beat upon the ear of the listener has caused them to be something over four inches longer than they otherwise would be, and a lower or flatter tone is heard. The same alteration in the tone value of the note takes place when the locomotive whistle is blown and the effect is more marked when the sound is a musical chord such as many chime whistles give. The alteration in tone is not so noticeable when the listener is some distance away and in a direction approximately at right angles to the track.

The greatest distortion of the sound would probably be noticed if the listener was on a fast train, moving in the opposite direction on a parallel track, for here the motion of both trains, banks up, or one might almost say, bunches the sound waves in front of the trains, and stretches them out or drags them apart after the trains have passed each other. In this way the bell sounding its fundamental note, rings true to the men on the engine, nevertheless at the same time, yields sharp C to the man beside the track ahead, and becomes C flat to him long before the flutter of the marker flags shows that the train has passed.

Appearance of Things at Night.

The British Medical Journal in a recent issue gives some explanation for the strange appearance which objects may assume when seen at night. Nearly every railroad man has had more or less experience of the changed appearance noticed occasionally in familiar things. Our British contemporary says:

"Every one must at times have asked himself why familiar objects in a dim light tend to assume fantastic and oftentimes alarming appearances. The explanation is to be found in the special conditions of night vision. The pupils are widely dilated and, as in the photographic lens with a large diaphragm, the apparatus of accommodation can only focus for one plane. As the faculty of estimating distances is in great measure lost in the obscurity, we cannot focus with precision, and a blurred, uncertain outline is thrown upon the retina.



OLD "SINGLE" IN FRANCE.

"The, too, colors viewed in a fading light lose their distinguishing hue in a fixed sequence until a point is reached at which everything becomes of one uniform gray tint. It follows that the images which are transmitted to the visual centres are profoundly modified in color and outline, and as they enter the eye through the widely dilated pupil at an altogether unusual angle the movement of locomotion gives them a peculiar mobility.

"Now, one relies on experience for the interpretation of sensorial impressions, and when these present themselves suddenly in an unusual form they create a feeling of insecurity which finds expression in mental perturbation and more or less violent motor impulsion. In fact, the subject finds himself in the position of a horse which sees a rapidly advancing automobile for the first time and does not know what to make of it.

"Imagination aiding, these blurred, mobile and uncertain images are susceptible of the most phantasmagoric interpretation, and in persons who are not accustomed to control sensorial impressions by the exercise of the intelligence the impressions are accepted as realities and acted upon accordingly. Gamekeepers and others who are accustomed to night work make allowance for phenomena of this class and correct the visual deficiency by the aid of other senses, such as hearing, which are not dependent on light."

Railroad Automobilists.

One would naturally suppose that railroad men would get all the riding they wanted by using fast trains; but no class in the community is fonder of the sport and excitement that comes from automobile riding.

Any conspicuous defect that will put the automobile out of service is viewed with decided impatience by railroad men, just as they have no use for locomotives that fail on the road and have to abandon trains. President Hughitt, of the Chicago North Western Railway, recently declared that the tire is the weak spot of an automobile and that it was not creditable to makers that tires continued to be so unreliable, a complaint we had good reason to endorse. The fact is that pneumatic tires have not been improved in durability since they were first introduced on bicycles. The unreliability of air inflated tires is working up sentiment in favor of solid tires. The growing favor that the buggy wheeled runabout is meeting with is due in no small measure to the solid tires used on such vehicles.

There is a substance on the market called Newmastic which makes an excellent filling for tires and is, we believe, destined to solve the difficulty with punctured tires. Newmastic is a springy substance used to fill the inner tube in place of compressed air. The writer has the four tires of an automobile filled with this substance and has run them over twelve hundred miles without the least trouble. In that service neither pump nor wrench has ever been used on the tires. The car rides as well as it did with pneumatic tires and there is wonderful comfort in the consciousness that no puncture is liable to happen at any moment.

To people who run automobiles for pleasure, and have their enjoyment frequently marred by tire troubles, we would say, get the inner tubes filled with Newmastic, and they will find that their tire troubles are much decreased if not abolished altogether.

Questions Answered

GAUGE OF DRIVERS.

47. B. S. asks (1) why is the hole in the link-block not in the center of the block?—A. It usually is in the center of the block. (2) Is there any difference in gauge between front and back drivers of an engine?—A. No there is no difference in gauge of wheels, there is generally more play allowed between hubs and driving boxes of center wheels in six and eight-coupled engines where all are flanged in order to allow the engine to go round a curve more easily.

COVERING STEAM PORTS.

48. B. S. asks what position will an engine have to stand in to have both ports covered? Can both be covered at the same time?—A. Yes, both can be covered at the same time. The ordinary slide valve has a certain amount of lap, and when it is in the center of its travel both steam ports are closed from live steam and exhaust. The valve, however, closes to live steam at the point of "cut off" and in full gear with 24 ins. stroke that may be after the piston has moved about 21 ins. In mid gear this closure may take place at about 16 ins. You can find the position by placing the engine with piston near the end of its stroke moving forward, opening the throttle so that steam will flow from the front cylinder cock and draw up the reverse lever toward center and when the flow of steam from the cylinder cock ceases both ports are covered. Both sides of the engine can be blocked at the same time, if the lap on the valve is large in proportion to the travel.

BRAKES IN FULL RELEASE.

49. Mr. J. J. M., of Denver, Col., asks: "In using Westinghouse air engineer left brake valve in full release position till train line and main reservoir equalized, then brought handle to running position, the brakes set on the tender and slid the wheels, but the brakes on the rest of the train did not set and engineer was unable to release tender brakes, what caused tender brakes to set on tender and not the rest of train? There were forty-five cars in train?—A. It is evident that the brake pipe leakage was insufficient to move the triple valves to application position during the time the brake pipe pressure was reducing to the adjustment of the freed valve, that is, the auxiliary reservoir pressure could reduce through the feed grooves into the brake pipe without moving the triple pistons, or if the pistons were moved the small amount of air leaving the reservoirs could pass through the leakage grooves in the brake cylinders. The fact that both the tender triple valve and the tender brake piston were moved and the brake applied under the conditions mentioned, indicates that the leakage groove in the cylinder was partly or entirely closed, or that there was a considerable difference between the auxiliary reservoir and brake pipe pressures when the triple piston and slide valve were moved. This difference in pressure could be caused by the triple valve not working freely and the feed groove being partly closed with dirt.

WEIGHT ON ENGINE TRUCK.

50. G. J. D., Panama, asks: What portion of the weight of the engine is generally carried on the engine truck where front truck and front driving wheels are equalized together, on an 85-ton engine, 4-6-2 class?—A. As an example of this class take the engine that was illustrated on page 233 of our June issue. The weight on the engine truck of the New York Central Pacific type locomotive is 46,000 lbs., and the weight on Trailer truck is 48,500 lbs. In the Pacific type of engine, about 18 per cent. of the total weight is usually carried on the engine truck, and about the same per cent. on the trailer truck, although these proportions, of course, vary as circumstances may require.

DAYLIGHT SAVING BILL.

51. M. E. A., Santa Barbara, Cal., writes: There is a bill before Parliament, in Great Britain, to alter the clocks in the first four Sundays in April and put them back in September. How does this save daylight, and how do they propose to work the scheme?—A. The plan is to begin on the first Sunday in April and between 2 and 3 A. M., alter the clock so as to gain 20 minutes. That is, when the clock markes 2:40 A. M. make it 3 o'clock. The week following is run on this advanced time. The second Sunday in April the same thing is done again. When the clock marks 2:40 A. M. it is then really 2:20 A. M., but it is advanced to 3 A. M. The second week in April is then run on a total advance of 40 minutes. The third week is run on a further advance of 20 minutes or a total advance of one hour, and the last week of April and all the summer is run on a total advance of 1 hour and 20 minutes. This means that the change is, so to speak, gradual in April, and as the working day begins 80 minutes earlier, railway men and other operatives in the United Kingdom have that much more daylight after their work is done. In the autumn the reverse process is carried out week by week in September, only the clock is put back 40 minutes each week. That makes a total retardation on the clock of 80 minutes all through the winter nonths, and approximately puts the working day more nearly in the daylight hours. This proposed legislation is in line with a good deal of law making of late years in the British Isles, where the interests of the working class are very carefully considered.

TROUBLE WITH AIR PUMP.

52. E. W.G., Hoffmanville, Md., writes: When the pump throttle is opened, the pump will make an up stroke and then a down stroke and stop there. Then when I close the pump throttle I hear something in the pump drop with a click. Then when I give it steam again it will make another double stroke and stop. All bushings and all packing rings seem O. K., and to make sure that the top head gasket was tight I put in a lead one. By slacking the stuffing box nut I find that the pump gets a strong flow of steam in the lower end of cylinder, but still will not lift piston unless the steam is shut off at pump throttle at every stroke.—A. The click you hear is no doubt the reversing valve and rod falling to its lower position when relieved of steam pressure, which indicates that the pump does not reverse at the lower end of its stroke, which may be due to some obstruction between the steam piston and the center piece or between the air piston and lower cylinder head or a valve rod that is too long between the button and the shoulder that engages the reversing plate. It is very seldom that the rod is not correct in length, but mistakes are sometimes made and rods have been found to be one-half inch too long. The distance from the shoulder to the button is 9⅞ ins., and if the rod is all right and the pistons are not obstructed you must be mistaken about the bushings and rings in the top head being in good condition, as it is not likely that the under surface of the reversing plate is worn enough to keep the pump from reversing its stroke.

The Channel Tunnel.

The British company interested in the construction of a tunnel under the English Channel, between England and France, have withdrawn the bill before Parliament which was so warmly promoted last year. The company has made great efforts in promoting the needed legislation, but so far without success. The committee are hopeful of success in the near future and there is no lack of funds. The distance from Dover to Calais is 24 miles. This would be the longest tunnel in the world, but the company claims that its construction would be easier than that of the Simplon and other tunnels. The rock is largely of the same chalk formation as the cliffs of Dover and would be easily cut through.

Celebrated Engineers.

IX. WILLIAM SYMINGTON.

After the complete success of Watt's steam engine had been universally acknowledged one would naturally suppose that its adaptation to moving mechanical appliances generally and locomotion particularly would have been rapidly accomplished. The reverse was the case. There is a conservative spirit in the great mass of humanity, especially in the Eastern hemisphere, to let matters go on as they are. Not only has ignorance been a constant drag on the wheels of progress, but even the most enlightened have been found blocking the path of improvement. In the case of the application of Watt's engine to the moving of ships there were important difficulties to overcome, among which were the weight of the engine and the fuel, the large space on the ship occupied by the engine and the tendency of the engine to rack the vessel and render it leaky. These, together with the cost of maintenance, were important obstacles.

Among the first to encourage steam navigation was Patrick Miller, a Scottish landed proprietor, who in 1787 published a description and drawings of a vessel moved with wheels turned by steam. With a view to testing his theories he had constructed a very handsome vessel to be used as a pleasure boat and on looking round for a practical engineer to try the application of steam as the propelling force he met with William Symington, who had been giving some attention to applying the force of steam to wheel carriages. Symington was an accomplished engineer, a native of Lanarkshire, where he was born in 1764, and educated in the Glasgow University. He was thoroughly familiar with the construction of Watt's engine, and in a few months he completed the construction of a marine engine which had brass cylinders four inches in diameter and applied it to moving paddle wheels on Miller's pleasure boat. Nothing could be more gratifying or complete than the success of this first trial, and while for several weeks it continued to delight Miller and his numerous visitors, on the approach of winter the apparatus was removed from the boat, and placed as a sort of trophy in Miller's private library at Dalswinton, where it is still preserved by the family as a monument of the earliest instance of actual navigation by steam.

TRACK TO GRAVEL PIT, PHILIPPINE RAILWAY, CEBU, P. I.
After one hour's rain the water took one-half mile of track down this stream about 2 miles

It must be borne in mind that there had been other experimenters in steam navigation before this date, although nothing of their work is left. Symington continued his experiments and a large vessel sixty feet long was constructed on the Forth and Clyde Canal and successfully operated in 1789. The engines were made at the Carron Iron Works. The cylinders were eighteen inches in diameter, and the vessel moved at seven miles an hour. The Forth and Clyde Canal Company objected to the use of the paddle wheels as calculated likely to damage the sides of the canal. The marked success of Symington's experiments, however, attracted general attention and he repeatedly seemed to be about to realize the success which he deserved. The Duke of Bridgewater ordered the construction of eight steam boats and Symington was preparing for the work when the death of the Duke put an end to the operation. Symington carried his project to London and endeavored to interest the British government in the construction of steam ships, but he met the same fate as Worcester and Savary had met from previous governments. Of course the usual granite monuments and marble busts recall the memory of the eminent engineer, but the rewards which he deserved fell to others. As to the priority of his claim to the adaptation of the steam engine to navigation there can be no doubt. In the successful operation of steam boats Symington led, others followed.

BALLAST TRAIN ON THE PHILIPPINE RAILWAY, CEBU, P. I.

Air Brake Department

The Air Brake Convention.

The 15th annual convention of the Air Brake Association was called to order by the president, Mr. G. R. Parker, at the Hotel Ryan, St. Paul, Tuesday, June 9, 1908. There was a large attendance and an unusually large number of ladies were present.

A letter from Governor Johnson was read in which he expressed his regret at not being able to be present. His secretary, Mr. F. A. Day, then addressed the convention, welcoming the members to the State and city and invited all present to visit the new State Capitol building. He then introduced Mr. E. W. Gawler, Mayor of St. Paul, and announced that the Mayor's talk would be "hot air" rather than on air brakes. The Mayor responded in an able and eloquent address, at the conclusion of which the president of the Air Brake Association delivered a very interesting and instructive address, after which the convention adjourned for ten minutes to allow the ladies to retire.

The report of the secretary was then read by Mr. F. M. Nellis, who also read the treasurer's report, Mr. Otto Best being absent. The secretary announced that the committee preparing the questions and answers on the E. T. brake equipment were still busy and that it was hoped that the report would be completed in time to be published in the 1908 proceedings.

Brake pipe leakage and automatic hose coupling were then discussed, and a suggestion that the association recommend a signal hose coupling that could not be coupled with the air brake hose was brought to a vote and the suggestion adopted.

It is generally understood that some action will be taken to prevent members who have had a record of a number of years in good standing, and who are now engaged in other business, from being dropped from membership of the association on account of non-payment of dues.

On the second day a letter from Mr. E. A. Moseley, secretary, Interstate Commerce Commission, was read which expressed his regret at not being able to be present. Mr. Moseley was represented by Mr. Borland, who in an address and in answering questions stated the following facts: That a decision of the Supreme Court holds that the law of the Interstate Commerce Commission is absolute and must be adhered to to the letter. That the air brake must be operative on at least 75 per cent. of the train. That no difficulty whatever is experienced in handling trains on the steepest grades with the air brake alone if the equipment is maintained in a reasonable state of efficiency. That it is against the law to bring a train to the terminal using the hand brake in case of an air pump or other air brake failure. That it is consequently against the law to bring a train down a grade when controlled by the hand brake. That it is against the law to cut out the driver brake on an engine when in road service and an additional penalty under the employers' liability act should any one be injured during the above violations of the law.

Mr. Blythe, of the Canadian Railway Commission, was then introduced. He announced that the work done by the Canadian Commission was identical with that done by the Interstate Commerce Commission.

PAY DAY IN THE CANAL ZONE.

Brake cylinder leakage tests were then discussed. Some very interesting facts were brought out, which resulted in a division of opinion concerning brake cylinder leakage tests for freight cars on repair tracks; some members favoring a test that would condemn the brake where the piston recession is ¼ of an inch or more in 3 minutes; others favored attaching a gauge to the triple valve exhaust port to note brake cylinder leakage and to condemn the brake when the leakage exceeded 5 pounds in 1 minute. It was decided to continue investigations for another year.

Mr. F. M. Nellis read a paper on the subject of "Break-in-Two of Long Passenger Trains," which was an able and instructive treatise on the subject. The discussion following brought out some startling facts. The H.-C.; Westinghouse equipment was discussed in this connection and this discussion on the H.-C. equipment and the papers on brake beam release springs and losses of braking power will make the report of the proceedings of the 1908 convention one that no air brake man can afford to be without.

Wrongly Used Triple Valves.

From the number of wrongly used triple valves on locomotives and tenders it would, at the first glance, appear that there are a great number of men employed in this line of work who are unable to distinguish the difference between the different types of triple valves. This may be true in some cases, but very often the lack of material is the real cause of the wrong triple valve or wrong auxiliary reservoir being used.

Sometimes it is intentional, and a small auxiliary reservoir, short piston travel, and a large triple valve may be desirable when the air brake is to be used on the engine alone in yard service, which may give a prompt release and rapid recharge, but when the engine is to haul a train of cars in road service the proper sized air brake equipment is absolutely necessary to a successful operation of the air brake.

Unfortunately the H 1 (F 36) or the P 1 (F 27) triple valves can be used on the same cylinder head, auxiliary reservoir, or bracket as the case may be, and occasionally the passenger triple is found on a tender equipped with an 8-inch brake cylinder and a 10x24 in. auxiliary reservoir.

When this occurs no difference will be noticed during the ordinary applications of the brake as the service ports of both triples are of the same size, but the feed groove of the passenger triple will allow the 10x24 reservoir to charge too fast and on trains of moderate length there is likely to be trouble from this brake re-applying after a release has been effected, if the brake cylinder is in good condition.

The stronger graduating spring used in the passenger triple under those conditions has a tendency to delay the emergency action and make it more difficult to obtain, especially when double-heading.

On the other hand the freight triple valve may be found on a 10-inch brake cylinder with a 12x33 reservoir, and in this case there will be no likelihood of the brake reapplying after a release, as the recharge will be entirely too slow for a second application unless this

brake is given more time than the rest of the brakes require in which to recharge.

During service applications this triple valve will then have a larger volume of auxiliary air to expand than for which it was intended, and resting against the weaker graduating spring the triple piston will have a tendency to assume the quick action position during service applications.

The P 2 (F 29) or "Pullman" triple valve cannot be bolted to the 10-inch brake cylinder head, but very often the triple valve is attached to a separate bracket on the tender and sometimes the wrong triple valve and bracket may be found.

The effect will be similar to those just mentioned, the "passenger" triple valve, if used with the 12-inch equipment, will be slow to recharge and have a tendency to work in quick action during service applications on account of the larger volume of air to be expanded through the smaller service port. The "Pullman" triple valve, if used with the 10-inch equipment, will overcharge the auxiliary when the brake is released and have a tendency to "stick" the brake about the time the train is pulling away from station stops.

Very often the F 46 triple valve is found on engines equipped with the high speed brake, 10-inch driving brake cylinders and 12x33 auxiliary reservoir. Substituting an H 24 triple valve reduces materially the number of workbook reports of "clean triple valve" and "triple valve sticks." Following is a table that will explain itself:

DRIVER BRAKE TRIPLE VALVES WITH OR WITHOUT TRUCK BRAKE OR HIGH-SPEED ATTACHMENTS.

Weight on Drivers.	Size of cylinder. Ins.	Style of triple.	Size of Reservoir.	Pressure developed in cylinder. Lbs.	New plate number of triple.	
Up to 40,000 lbs......	8	H 24	10 x 33	2,500	F 1	Brk. cyl. pressure 50 lbs. per square inch.
40,000 to 85,000......	10	H 24	12 x 33	4,000	F 1	
70,000 to 115,000.....	12	F 46	14 x 33	5,050	F 2	
110,000 to 170,000.....	14	F 46	16 x 33	7,700	F 2	
145,000 to 225,000.....	16	F 46	16 x 42	10,050	F 2	
Weight of Tender:			PASSENGER ENGINE TENDERS.			
Up to 30,000 lbs......	8	F 36	10 x 24	3,000	H 1	
30,000 to 47,000......	10	F 27	12 x 33	4,700	P 1	
47,000 to 68,000......	12	F 29	14 x 33	6,700	P 2	Brk. cyl. pressure 60 lbs. per square inch.
Weight of Car:			PASSENGER CARS.			
Up to 47,000 lbs......	10	F 27	12 x 33	4,700	P 1	
47,000 to 68,000.......	12	F 29	14 x 33	6,700	P 2	
68,000 to 92,000.......	14	F 29	16 x 33	9,200	P 2	
Over 92,000...........	16	F 29	16 x 42	12,050	P 2	
Weight of Car:			FREIGHT CARS.			
Up to 15,000 lbs......	6	F 36	....	1,700	H 1	
15,000 to 40,000.......	8	F 36	....	3,000	H 1	
Over 40,000...........	10	H 49	....	4,700	H 2	

The G 24 and F 25 triple valves are now obsolete, but when it is necessary to use them they should be used only on freight or switch engine tenders, the G 24 with the 8- and 10-inch brake cylinders, the F 25 with 12- or 14-inch cylinders.

In India there were 952 miles added to the railway system during the year 1906-7, making a total of 29,571 miles up to March 31, 1907. The mileage under construction amounts to 2,873.

The High-Speed Brake.

About 12 years have elapsed since the introduction of the high-speed brake; it has in the meantime been advertised and its merits exploited sufficiently for anyone interested in air brake matters to become familiar with its operation and the advantages derived from its use. From a mechanical standpoint it is a remarkable success, having greatly reduced—in fact, almost entirely overcome—the trouble and expense of slid flat wheels, which is due to the auxiliary reservoirs containing enough air pressure to fill the brake cylinders and produce an equal braking power on every car, regardless of the piston travel, so long as the shoes can be drawn against the wheels, which avoids the action of a car with the average piston travel being compelled to assist in stopping other cars in the train that have a longer piston travel and consequently a lower brake cylinder pressure, as is frequently the case where the ordinary quick-action brake is in use.

As a safety device it entirely overshadows the mechanical features, and it must be considered as a safety device, as the ordinary service features of both brakes are identical, yielding approximately the same number of pounds' brake cylinder pressure for the first 10, 15 or 20 lbs.' brake pipe reduction, therefore the high-speed feature is manifest only during emergency or quick action applications.

A train of cars in motion may be said to store up an energy which must be destroyed by the brake when the shortest possible stop is desired. Increasing the speed multiplies this energy and the co-efficient of brake shoe friction decreases with the increase of speed.

For instance, if a train running at the rate of 30 miles per hour can be stopped in a distance of 400 ft., five times the distance or about 2,000 ft. will be required in which to stop the train if the speed be increased to 60 miles per hour.

It is therefore apparent that a brake may be satisfactory at low speeds and at the same time be inefficient at high speeds and for this reason the high-speed brake was designed, it being about 30 per cent. more efficient than the quick action brake cutting off hundreds of feet in each stop in cases of emergency. The engineer does not need an emergency brake often, but when he does need one he needs it badly and the best brake obtainable.

Actual tests have demonstrated that at 45 miles an hour a train properly braked can be stopped in a distance 710 ft. by the quick action brake and at 70 miles an hour the train will be stopped in 2,020 ft.

Under the same conditions the high-speed brake will stop the train at 45 miles an hour in 560 ft. and at 70 miles an hour in 1,560 ft., shortening the stop 150 ft. at 45 miles an hour and 460 ft. at 70 miles.

The stop in feet does not even represent the value and efficiency of the brake when there is danger from a rear end collision, with the head train in motion, for the co-efficient of brake shoe friction increasing rapidly, with the decrease in speed, allows the point of contact to be moved farther away each instant.

In spite of these well known facts some railroad companies operate heavy passenger trains at the highest possible speeds with the ordinary quick action brake, and if a railroad company is unwilling to expend a few additional dollars to protect or insure their property against destruction as much as they possibly can by providing for their cars and locomotives the best brake obtainable, it is unreasonable to expect anyone else to be concerned about their property, but when a passenger pays his fare on a railway train he is entitled to as much protection as possible to his life and property from all railroad companies alike.

Many railroad accidents resulting in a loss of life and destruction of property have occurred where, if the train could have been stopped in a few hundred feet shorter distance, no accident whatever would have occurred.

Other accidents have occurred where, if the collision could have been delayed a few seconds, no loss of life whatever would have resulted and the damage to the company's property would have been comparatively trifling.

The efficiency of the high-speed brake under such conditons is too well known to admit of any argument against it, and sooner or later, probably after some disastrous wreck, it may occur to some interested parties that there is occasion for an investigation along those lines by the Safety Appliance Inspectors of the Interstate Commerce Commission.

Electrical Department

Fuses and Automatic Circuit-Breakers.

By W. B. Kouwenhoven.

Fuses and automatic circuit-breakers perform the same function for an electric installation that the safety valve performs for the steam boiler. The safety valve protects the steam boiler from injury in case of a rise of steam pressure above normal, by allowing the excess steam to escape. A fuse or circuit breaker opens the electrical circuit when the current reaches too high a value and protects the apparatus from damage. Every steam boiler is provided with a safety valve, and every electrical installation, no matter what its character, should be provided with one or the other, or both, of these protective devices.

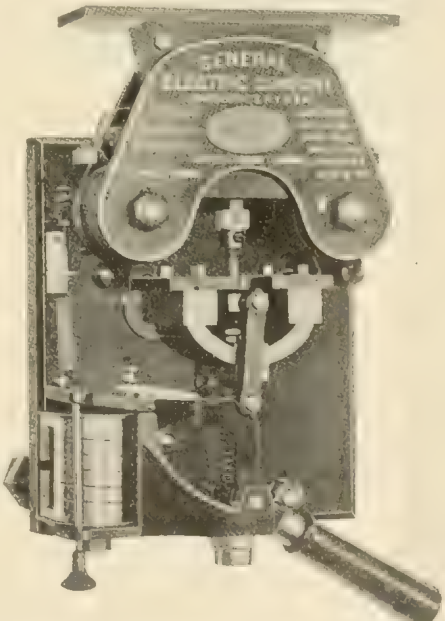
There is a common impression that fuses and automatic circuit-breakers are alike in their characteristics, but such is not the case. They both perform the same function, namely that of opening the circuit. The circuit-breaker, however, depends for its action upon the quantity of current in the circuit, while the fuse depends not only upon the quantity of current flowing, but also upon the duration of the flow. A fuse, as its name implies, is simply a link of metal placed in an electrical circuit so that when the current rises above a certain value it is heated to the fusing point, is melted and thereby opens the circuit.

A number of different metals are used in the manufacture of fuses, the most common being copper, aluminum, and an alloy of tin and lead. This alloy, in the form of fuse wire, is used for almost all fuses of low capacity. For the larger capacities, copper or aluminum strips are more satisfactory, owing to the smaller volume of material to be melted when the fuse is blown.

The melting of a fuse with the consequent opening of the circuit is always followed by a flash or arc, as it is called, which, although of short duration, forms a quantity of hot vapor, which scatters the molten metal. The blowing of a fuse, as it is usually termed, is likely to set fire to any inflammable material that may happen to be with in reach of the hot metal. Fuses are usually enclosed in some form of a fire-proof receptacle, owing to this fact.

Fuses are more or less sluggish in their action, due to the fact that it requires a considerable quantity of heat to raise the temperature of the fuse to its melting point, and that an appreciable time is required to generate this quantity of heat. This characteristic of a fuse is known as the "overload time element," or the "time-lag" of a given fuse. This refers to the time required to blow the fuse and open the circuit after the current has reached a given overload value.

This overload time element forms one of the main features of the fuse. Before a current will raise the temperature of the fuse to its melting point a certain amount of time must elapse. The amount of time varies with the value of the current, and rapidly decreases as the current increases. For example, a 400 ampere, 600 volt enclosed fuse will carry 450 amperes indefinitely. It requires about ten minutes to open it at 600 amperes, and two minutes at 800 amperes; 1,000 amperes will cause it to fuse in about thirty seconds, and 2,000 amperes will open it in less than seven seconds.



MAGNETIC BLOW-OUT CIRCUIT BREAKER

The time element increases with the capacity of the fuse, for instance, a 30-ampere fuse at fifty per cent. overload will open in about one-half a minute, while a 400-ampere fuse will require about ten minutes with a corresponding overload. The larger fuse requires a much longer time to reach its melting point on account of its greater dimension and greater heat capacity than the smaller fuse.

The principal forms of fuses are the link, plug, enclosed cartridge, and the expulsion type. The link fuse is the simplest type of fuse and consists chiefly of a piece of fusible metal placed between the two terminals of a fuse block. The accurate rating of a link fuse is a very difficult matter. A fuse lying on a porcelain base is cooled thereby, and will take a longer time to melt than one suspended in the air. A fuse mounted in a thoroughly ventilated receptable has a greater current carrying capacity than one in air-tight box. The terminals between which a fuse link is connected, absorb considerable heat, especially if the fuse is short. Link fuses are used on nearly all motor cars to protect the motors, and are mounted in an accessible place on each truck, having a third rail shoe.

The fuses used consist usually of copper ribbon or of a soft, braided copper wire. One of the chief troubles found with the operation of these fuses is that the vibration of the train in time tends to crystallize and disintegrate them. The type of fuse that is used on the New York Subway is practically free from vibration, and has been very aptly described by a practical railroad man as the "feather-bed" fuse. It is suspended in such a manner that the vibrations and jars of the train do not affect it.

The plug type of fuse is rarely used on circuits above 125 volts and 30 ampere capacity, and is almost never used in railway work. The enclosed cartridge fuse can be accurately rated, and is much more definite in its action as the conditions are more nearly uniform than in the case of link fuses. The fuse itself is surrounded with either a fibrous or powdered insulating material, and no visible arc is formed when the fuse it blown from which the name "non-arcing" fuses is derived. This type ranges from 30 amperes, at 250 volts, up to very high voltages and large ampere capacities. These fuses are used in the 600 volt sizes to protect the lighting circuits of motor cars.

The expulsion type of fuse is used on the high-voltage circuits, and it is not a common type.

An automatic circuit-breaker, or simply a circuit-breaker, as it is usually called, is an automatic switch device, which has as an integral part a tripping coil, which, when the current rises above a predetermined value will disengage or trip a catch and allow the

breaker switch to be opened by a spring.

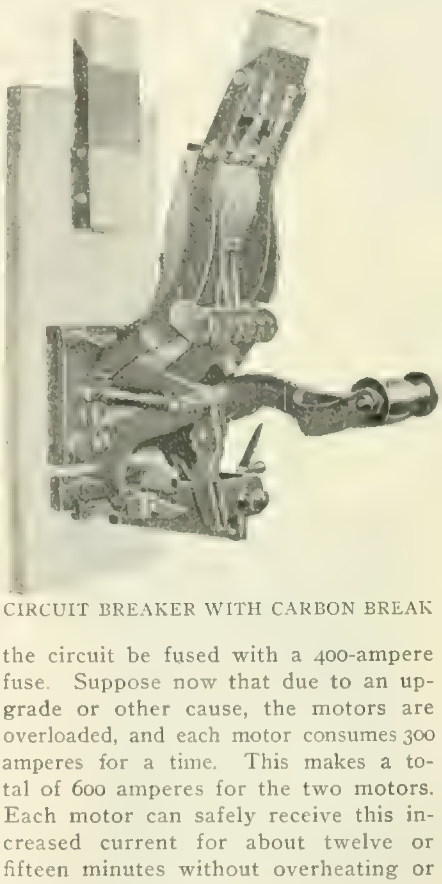
There are many different types of circuit-breakers, all of which work practically upon the same principle. A circuit-breaker consists of some form of a switch, which is closed against a powerful spring, and is held closed by means of a trigger. This trigger or tripping device, forms the armature of a solenoid, which is connected in series with the line. The solenoid consists of a few turns of heavy wire, through which the current flows. Attached to the trigger is a light spring whose tension is adjustable. This spring holds the trip away from the solenoid. When the current passing through the solenoid rises above the value for which the trigger is set, the solenoid attracts the trigger, which releases the powerful spring and immediately opens the switch, giving a very quick break. The value of the current that will open the breaker may be adjusted through a considerable range by changing the spring, which holds the trigger away from the solenoid. The switch element of a circuit-breaker consists of either a knife switch or of laminated copper blocks, which are held in close contact. When the break occurs these copper contacts or switches would be damaged by the arc, unless some means for preventing the formation of the arc is employed.

There are two devices which are used to prevent the burning of the main contacts. One is by the use of auxiliary carbon blocks, which remain closed for a fraction of a second after the copper contacts open. The arc then occurs between the carbon blocks and does not injure the main contacts. The blocks may be easily renewed when burnt out. The other device consists of providing the breaker with a magnetic blow-out coil, which interrupts the arc. The contacts are arranged so that upon opening they form the arc in a magnetic field. A solenoid usually provides the magnetic field required, as well as operating the tripping device. This form of circuit-breaker is almost universally used on railway installations and on motor cars.

A circuit-breaker is without the time element; that is when the current rises above the value for which the trigger is set, the solenoid immediately attracts the trigger and trips out the switch. The action is instantaneous. Circuit-breakers can be made so that they will handle successfully any current and any voltage.

The question of whether fuses or circuit-breakers should be used in any particular case depends upon a great many conditions. A fuse has, as we have seen a time element and has a low first cost, but each time the fuse blows there is a definite expense for renewal. On the other hand, the automatic circuit-breaker is instantaneous in action, and can be set as required to open at various current values. Although it has a high first cost, it will perform its duty of opening the circuit many times without any additional expense. The use of both fuses and automatic circuit-breakers connected in series in the same circuit is a very common practice, especially in railway work, and on motor cars and trolleys.

In order to illustrate the use of the two devices, let us briefly consider a motor car whose two motors take 200 amperes apiece, normally, and suppose



CIRCUIT BREAKER WITH CARBON BREAK

the circuit be fused with a 400-ampere fuse. Suppose now that due to an upgrade or other cause, the motors are overloaded, and each motor consumes 300 amperes for a time. This makes a total of 600 amperes for the two motors. Each motor can safely receive this increased current for about twelve or fifteen minutes without overheating or damage. The fuse will carry this overload for about ten minutes and then it will melt and open the circuit, provided the overload continues for that length of time. If before the fuse has reached its melting point the current falls back to its normal value, the fuse will cool down and will not open the circuit. But if the increased current had continued, the fuse would have blown in time to prevent injury to the motors.

If the overload was caused by a sudden short circuit and the current should rise to 500 amperes per motor, the motors would be instantaneously damaged before the fuse has time to act. With a circuit breaker set to open the circuit at 900 or 1,000 amperes, its action is as prompt as the emergency. When the short circuit occurred it would act instantly, and open the circuit before harm could be done to the motors. It is not advisable to set the breaker to open at 600 amperes, because a momentary overload that might raise the current to this value would open the breaker, although the overload would not injure the equipment unless it was of long continuance, and then the fuse would take care of it successfully. It would be a great nuisance to have the breaker coming out frequently when climbing a short, steep grade or starting a heavy train.

The fuse and the circuit-breaker has each its peculiar functions. In ordinary installations the fuse is designed to protect the motors in case of a more or less gradual rise of current value and the time element which is one of the properties of the fuse is useful in preventing too sudden action. The circuit-breaker acts with exceeding promptness and responds instantly to a sudden short circuit overload. It may be said that the fuses will allow certain fluctuations of current with the danger point delayed for a brief interval of time, while the circuit-breaker acts like the swift parry of the practised swordman and guards the vital parts of the mechanism against the powerful and sudden thrust of the short circuit overload.

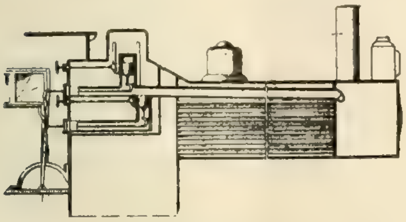
Carelessness and Criminal Negligence.

At the Old Bailey police court in London, before Justice Bingham, William John Hollis, signalman, in the service of the Metropolitan District Railway, was indicted for manslaughter in connection with the collision between two electric trains, which occurred in the fog at West Hampstead Station, when three persons lost their lives. Prisoner pleaded "not guilty," and gave evidence on his own behalf, stating, in cross-examination, that he recognized that his testimony was in direct conflict with that of the principal witnesses for the prosecution. The judge in summing up said that before the jury convicted they must be satisfied that the accused was guilty of culpable negligence. Mere negligence in the discharge of his duties was not sufficient to constitute the offence, and gross and criminal negligence must be proved. His (the judge's) own opinion was that the prisoner was careless, did not take due precautions, and had told a parcel of falsehoods to explain his conduct. The prisoner was acquitted and discharged. It will be noted that juries do not always take hints from judges in regard to the innocence or guilt of a person. In this case the jury gave the prisoner the benefit of the doubt.

Patent Office Department

THROTTLE.

J. W. Kennedy, Burke, N. Y., has patented a throttle, No. 887,944. The device includes a valve arranged to work in a valve seat, a pipe communicating with the seat, a sleeve communicating with the pipe, a gland for the sleeve and means for operating the

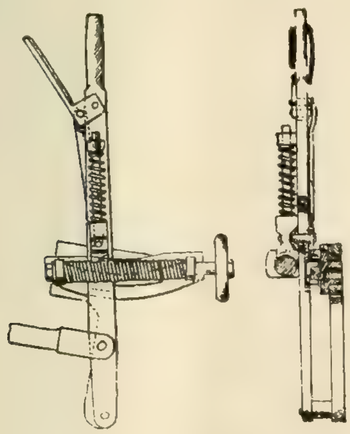


THROTTLE VALVE.

valve. There is also a second valve, a pipe communicating with the first named pipe and having a valve seat at its point of communication with first named pipe, and valve operating mechanism located within the second named steam pipe and means for operating the mechanism.

HAND LEVER.

H. M. Dodd, Moultrie, Ga., has patented an important improvement in hand levers, No. 856,451. The device can be readily applied to locomotive reverse or throttle levers, and consists of a lever fulcrumed on the usual way on a base, a guide block pivotally connected to the lever, a spring pressed

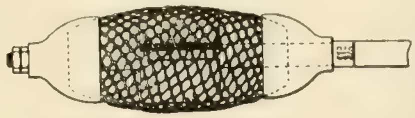


THROTTLE OR REVERSE LEVER.

latch block slidably mounted upon the lever, a guide plate pivotally mounted on the base, the guide block slidably engaging the plate and disposed to rock it during the actuation of the lever. A revoluble adjusting screw is supported by and movable with the plate and is engaged by the latch block. The mechanism affords a very minute adjustment of the lever and precludes the possibility of a sudden movement or lost motion in the lever.

FLUE-SCRAPER.

A flue-scraper has been patented by E. F. Fletcher, Worcester, Mass., No. 886,362. As shown in the illustration the apparatus is furnished with a central flexible scraping section of intermeshed wire. There is an annular spring inclosed in the central section provided with outwardly projecting

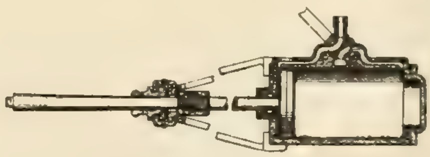


SCRAPER FOR CLEANING FLUES.

spurs to engage the meshes of the wire, whereby the spring is made to conform with the change, in form of the central section when the diameter is varied.

FLUE-EXPANDER.

A pneumatic flue-expander has been patented by H. Kelly, Houston, Tex., No. 888,239. The device includes a cylinder with piston, and means for admitting a motive agent alternately to opposite ends of the cylinder, of arms projecting from one end of the cylinder and connected at their ends by a collar having a central opening and a peripheral groove. There is a die formed of a plurality of sections and having a bead at its outer end and

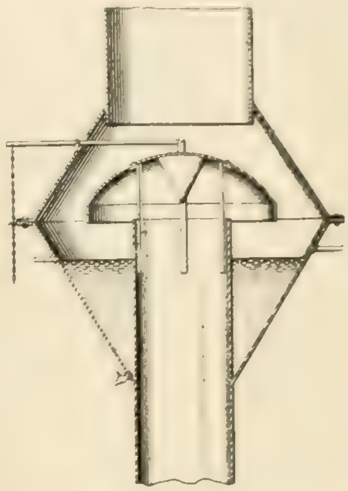


AIR OPERATED TUBE EXPANDER.

a groove at its inner end furnished with clamps and a spring encircling the clamps, and a tapering pin extending through the die and collar and having its ends secured to the piston rod.

SPARK ARRESTER.

A spark arresting device has been patented by L .H. Starrett, Portland, Ore. No. 881,735. The apparatus embraces a smoke stack, an inverted truncated cone secured around the upper portion of the stack or duct to constitute with the latter a water-containing receptacle, a cone resting on and secured to the upper end of the lower cone and provided with an opening in its wall. There is an upper duct arranged in axial alignment and extending into the upper cone. A hood is attached to the upper cone and provided with flexible vertical members

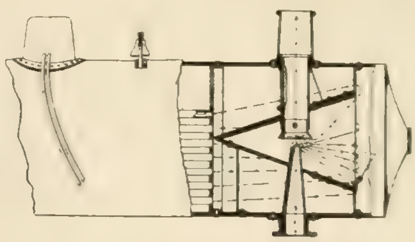


LOCOMOTIVE SPARK ARRESTER.

which engage the internal surface of the lower duct. A lever and fulcrum are attached for actuating the hood.

DRAFT-REGULATOR.

A locomotive draft-regulator has been patented by W. A. Skinner, Moberly, and T. F. Cain, Montgomery City, Mo., No. 887,278. The device embraces a combination with the smoke-box, stack and exhaust nozzle, of a funnel supported in the smoke-box with its open end foremost, the upper end of the exhaust nozzle and the lower end of the draft pipe projecting into the



DRAFT REGULATING APPARATUS.

funnel. There is a flared thimble connected to the lower end of the draft pipe, and a damper in the draft pipe outside of the funnel.

Hopeful.

Excited Traveler — Porter, porter, can I catch the 3:30 for Bristol?

Porter—Well, look 'ere, sir. Can ye run? It's only been gone out o' the station about three minutes.—Bristol Mirror.

General Foremen's Association.

(*Continued from page 296.*)

right side there must be some resistance or strain of some kind.

I have prepared sketches showing the right and left main crank pin in different position. Sketch No. 1 shows the right crank pin approaching the forward center and the left pin the top quarter. If the engine is working in the forward motion the power developed by the steam in the left cylinder is in the direction of the arrows shown on sketch. This would practically make the left front pedestal jaw a fulcrum between the left crank pin bearing and the right pedestal jaw. After the point of cut-off on the right side has been passed and the pressure in the back end of the right cylinder greatly reduced, whatever lost motion there might be in the right driving box or in the shoe or wedge, would be found at the points marked X in the sketch. Consequently when steam is admitted to the front end of the right cylinder no pounding would be heard, although there might be considerable lost motion in the right driving box. As the wheels revolve and the right pin approaches the bottom quarter, and the left pin the forward center as shown in sketch No. 2, a slightly different combination is found. The lost motion in the driving box will be at X, shown in sketch, and when steam enters front end of left cylinder there will be a pound if there is any lost motion in the left driving box. According to this view, it will be seen that as long as the engine is working in the forward motion the left side acts more or less as a slack adjuster for the right side.

This would give the right side an advantage over the left side. I believe this has more or less to do with, if it is not the direct cause, of the left side pound.

To illustrate what we found on one of our high-speed engines after having made 154,570 miles. This engine was received from the works December 28, 1905, and taken in shop for general repairs November 14, 1907. We found the left main shoe worn one-fourth inch and the right main shoe one-eighth inch. This is a very good illustration that there is something on the left side which causes this.

On November 20, 1907, we turned a Pacific Type engine 6416 out of back shop after receiving a general overhauling, and up to February 29, 1908, this engine made 26,826 miles. When this engine left back shop I personally spoke to the engineer in charge and told him to watch the left main driving box, which he did. The engineer in charge of this engine watched the driving boxes on this engine himself; he set up the left main wedge during the time I just mentioned one three-eighths inches, while he only set up the right main about five-eighths inches. I am positive that there was no pound on the left main driving box on this engine from the time she left back shop until February 29, 1908, but I attribute this to the carefulness of the engineer in watching the wedges of the left main driving box. However, I know that if the engineer in charge of this engine had not watched the left main driving box there would have been a pound.

I believe the illustrations I have given you will prove that there is something on the left side of an engine which causes this pounding. I am satisfied it is not in the counter-balancing of the wheel, as we have weighed the counter-balance and reciprocating parts on a Pacific Type engine and found them to be exactly correct.

Now, I have tried to give you all I know about the pounding of the left main driving box and I will be pleased to hear from all of you on this topic, as I think it is a very important one and should have technical consideration.

C. H. Voges,
Bellefontaine, O. N. Y. C. Lines.

This is a subject that has been before the railroad men for a good many years, and has been discussed, pro and con, by the railroad men all over the country.

A great many reasons have been assigned for it, but in my mind there is very little to be said on the subject. That it does exist, there is no question, and on all locomotives.

The right side of the locomotive being the lead, the lost motion is concentrated in the left, thereby producing a pound; the more lost motion, the greater the pound.

When the engine is put in the reverse motion the pound will transfer to the right side.

If the engine is properly taken care of, the lost motion kept up, such as wedges, driving box brasses and rod brasses, the pound is not sufficient to cause any great alarm, or do any great amount of damage.

It has been said by some that it was due to the engineer not taking as good care of the left side of the engine as he does of the right, but I do not think very much of this theory.

Then again, I think the counter-balancing of our engines has a great deal to do with the pounding. I think our present method of counter-balancing is to a great extent guesswork. For instance, an engine is counter-balanced so she runs very smoothly at a certain speed, but when you increase or decrease that speed, she does not run so smoothly and then the pound is more perceptible. I think if our engines were properly counter-balanced, the pound would be alleviated to a great extent.

E. R. Berry,
Galesburg, Ill. C., B. & Q. R. R.

There are several causes that we find which would result in making an engine pound in any one particular box. For instance if the crown brass was bored too large for the journal and put up in that condition, especially on the main pair of wheels, the engine would develop a pound almost immediately, although this would not show up so bad if on any other pair. The main boxes on any engine will begin to pound before any other box; that is if the same care has been taken in fitting brasses, shoes and wedges, etc. The reason for this is that the power is transmitted directly to this pair of wheels from the cylinder; they in turn transmitting the power to all the other drivers, thus putting a heavier strain on these boxes. The proper laying off of shoes and wedges has much to do with driving boxes pounding and so slightly it will cause a bad pound almost as soon as an engine is put in service. Especially is this true if the journal is flat through center line of motion or when the pin is a little below front center line. Also an engine that for any reason carries more steam on the left side than on the right will cause a pound in the left main box on account of the greater amount of friction caused by this side doing more work. I have often thought that excessive lead on one side of an engine, this lead of course being caused by a slipped eccentric or by putting up an eccentric in round house without running engine over to determine where it was set, will cause a pound on that side, in preference to the other. This is due to the greater pressure exerted on the pin at center line of motion as would be the case with the larger port opening at this point caused by excessive lead, causing journal to pound back and front of brass. I think that if more pains were taken in laying off shoes and wedges, getting engine and rods in perfect trim, also fitting driving boxes so there would be a bearing for nearly half a brass, and seeing to it that wedges were set up properly at all times, the pounding of driving boxes would be reduced to a minimum.

W. D. Kidneigh,
General Foreman, Union Pacific Ry.
Grand Island, Neb.

Modern Shop Construction.

Topic No. 2 was on modern shop construction. It deals with cross of longitudinal pits, location of wash rooms and lavatories, best location for each department, care of shop order material and convenience of storage. The subject was taken up by Messrs. L. H. Bryan, D. E. Barton and E. F. Fay. The report will be printed in a future issue. Topic 3 reporting work vs. engine inspection. Topic 4, the apprentice question will be taken later.

TOPIC NO. 5.—THE MILEAGE OF A LOCOMOTIVE—ITS RELATION TO COST OF SHOP AND RUNNING REPAIRS—DOES IT PAY TO OVERHAUL AN ENGINE THAT WILL GIVE BUT 90 DAYS FLUE OR FIRE BOX SERVICE—HOW COULD THIS BE HANDLED—WHO SHOULD DETERMINE WHEN TO SHOP AN ENGINE AND WHO SHOULD FURNISH THE WORK REPORT?

"Mileage of a Locomotive, Its Relation to Cost of Shops and Running Repairs," is in my opinion a subject which should not be slighted, for in doing so, it will probably give a wrong impression, as all the details of shop schedule would have to be gone through, with its expenses in relation to engine mileage. The mileage of engines in different class of service and in different localities should be considered in the total mileage expected. The cost of shop and running repairs should be handled as economically as possible. The different class of repairs are to be considered in shopping an engine; light repairs should be such that will cost for labor and material from $50 to $400, heavy repairs from $400 to $1,000, and general repairs from $1,000 up. Gangs should be organized with foreman in charge of each to handle the different class of work. Also a floating or extra gang, which could be used to assist in forcing along work which was behind in the schedule, or to take men from to fill out where any were absent in other gangs. There is always sufficient work in shops which this extra gang could be used on when not doing as above mentioned. The work and the number of men in the different gangs should be so planned that one gang would not have more work to do than would allow them to keep up with the schedule as laid out. The work at the machines should likewise be so planned. If all the details of organization are not closely watched the cost of output will invariably increase. In case of running repairs the reports of engineers and inspectors should be closely watched, and all class of repairs be made promptly, as neglect of this class of work invariably leads to more serious defects and consequently more expensive. Also the keeping of running repairs up in good shape will increase the life of an engine and lengthen the time between shoppings.

"Does it pay to overhaul an engine that will give but 90 days flue or fire box service? How could this be handled?" It would not pay to overhaul an engine that will give but 90 days service of flue or fire box. I think the conditions at point of shopping, also the size of power to be overhauled ditions as mentioned does not exist, should govern this. If there were local or branch runs where this power could be used for 90 days or the power could be used in yard service for that period, this should be done; if the conditions as mentioned do not exist, then I believe it would be a wise move to repair flues or fire box at the time of machinery overhauling.

"Who should determine when to shop an engine? And who should furnish work report?" The mileage made by engines should, to a great extent, govern the shopping, but in cases where engines have not made their allotted mileage and are unfit for service, continually having failures on the road, then the general foreman and road foreman of equipment should take these cases up with their master mechanic, stating the facts. The work reports should be furnished by the engineer who runs the engine, if regularly assigned to this engine. The engine inspector, round house foreman and road foreman of equipment, if engine was in pool service, the work report from engineer would be done away with. Also when engine arrived at shops and was stripped, a competent inspector should go over each part thoroughly, noting wear of parts, adding his report to that of the others for the information of the general shop foreman.

"G. E. BRONSON,
C. R. I. & P. Ry."

Roswell, Colo.

TOPIC NO. 6.—WHY DO STAY-BOLTS BREAK MORE FREQUENTLY ON LEFT SIDE?

Your committee has advised with a number of general foremen of boiler shops, whom it was possible to visit personally, and have taken the matter up by letter with others. The general conclusion from the data obtainable is that there is no reason, so far as can be learned, why stay-bolts should break on the left side of the locomotive fire-box any oftener than upon the right side. The data which appears in the tables given below serves to indicate the general trend of present practice. It has been suggested that the practice of using the injector on the left side almost exclusively, that obtains on some roads, might explain in some cases why the condition suggested by our subject might prevail. This, of course, would be the result of the widely varying temperatures and resulting stresses set up in the steel, brought about by the frequent injection of cold feed water. It is clear, of course, that the flow of the cold feed water is downward along the barrel and around the bottom section of the mud ring. However, it must be said that this reasoning is not conclusive, as the data obtained fails to substantiate the proof. We feel that there is no need of considering in this connection what conditions might result from the use of an inferior supply of stay-bolt iron, or from side sheets that might have accidentally passed inspection. In other words, it is not within the province of this report to consider matters which might be classed as constructive accidents.

Below, in Table No. 1, is given the report from the foreman boilermaker of the Chicago & Erie Railroad, secured and presented by Mr. W. H. Clough:

TABLE 1.

*Engine No.	Broken Stay Bolts. Left Side.	Broken Stay Bolts. Right Side.	Excess Left Side Over Right Side.
1756	[illegible]	47	[illegible]
1757	41	[illegible]	[illegible]
1758	45	[illegible]	[illegible]
1759	31	26	[illegible]
1760	23	27	[illegible]
1761	19	25	—6
1762	[illegible]	[illegible]	[illegible]
1763	36	[illegible]	[illegible]
1764	73	[illegible]	[illegible]
1765	20	[illegible]	17
1766	18	22	—4
1767	14	[illegible]	[illegible]
1768	27	39	—12
1769	36	40	—4
1771	22	[illegible]	[illegible]
1773	27	28	—1
1774	31	29	2
1775	27	[illegible]	[illegible]
1777	[illegible]	[illegible]	[illegible]
1778	[illegible]	[illegible]	[illegible]
1779	11	[illegible]	2
1780	5	[illegible]	[illegible]
1782	12	[illegible]	[illegible]
Total	622	628	—6

Table No. 2 presents the record of stay-bolts from the Urbana shops of the Cleveland, Cincinnati, Chicago & St. Louis Railway, Peoria and Eastern Division, the data being compiled from February 1, 1908, to May 1, 1908.

TABLE 2.

Engine No. Type.	Broken Stay Bolts. Left Side.	Broken Stay Bolts. Right Side.	Excess Left Side Over Right Side.
6166—Ten Wheel Frt....	0	3	—3
6167—Ten Wheel Frt....	7	18	—11
6231—Ten Wheel Frt....	7	23	—16
6160—Ten Wheel Pass...	10	15	—5
7076—Eight Wheel Pass.	4	4	[illegible]
7081—Eight Wheel Pass.	7	3	4
7080—Eight Wheel Pass.	4	10	—6
6596—Consol. Hvy. Frt..	7	5	2
Total	46	81	—35

It is the wish of your committee that all of the members of the Association who are in position to present data upon this subject shall do so.

With the data in hand, as has been suggested before, the inevitable conclusion is that there is no scientific reason why stay-bolts should break more often on the left side of the fire-box than on the right side, and further, that such a condition is not borne out by facts.

A. BRADFORD, Chairman.
Urbana, Ills. Big Four.
W. H. CLOUGH,
Hammond, Ind. Erie Railway.

TOPIC NO. 7.—THE QUICK DISPATCHING OF ENGINES AT TERMINALS AND HOW TO HANDLE MOST ECONOMICALLY.

This entirely depends upon the facilities and the condition in which the

*Data from 100 ton freight engines

engineman delivers his engine to the cleaning pit. You may have a modern cleaning pit, coaling and sanding station and an engineman to deliver his engine to the cleaning pit dry and a boiler full of water, and when received in this condition, with a modern cleaning pit, coaling and sanding station, the power can be dispatched very quickly and with little cost. But, where you receive an engine at the cleaning pit with flues leaking and with no modern facilities for handling cinders, coal and sand, it requires a great deal more time to handle the engine, thus reducing the quick dispatching of this engine and increasing the cost. Again an engineman may deliver his engine to the cleaning pit dry and have but very little water in the boiler. This retards the quick dispatching for this engine should not have the fire cleaned until the boiler has been filled with water, for it certainly is injurious to an engine to clean the fire and then pump the boiler full of cold water. This, I think, is the prime cause for so many flues that start leaking on the cleaning pits. All this retards quick dispatching. Instructions issued to the enginemen by our master mechanic are to deliver engines to the cinder pits with a full boiler of water and no water must be put in the boiler until the fire has been cleaned and a bright fire placed against the flue sheets and the engine started for the round house and filled up while in motion. Another thing which adds to the quick dispatching of power is that the dispatcher and yardmaster and round house foreman are in touch with each other and are working in harmony. The dispatcher will very often ask the engineman at a close office to the terminal if his engine is in condition to go right back on arrival. If his reply is "Yes," and the yardmaster will rush him through the yards to the cleaning pit it will add greatly to the quick dispatching of power. Along the line of quick dispatching of power at a terminal, I might say that we have to have the co-operation of the enginemen and have them take the best care of their engines while on the road. An engineman should set his injector to supply the boiler over the division and then avoid, all he can, putting in water standing still. Engines that are handled in this manner you can most always turn quickly at a terminal. But where an engineman will let the water get low and slap on one injector, and probably both of them, and fill the boiler quickly with cold water, and make a practice of filling his boiler at water tanks, he is always having flue trouble. When engines are received at the cleaning pits, leaking, it prevents the quick dispatching of power. On the road is where the power must be taken care of if we expect to have good results in the quick dispatching of same. The flue question seems to be the main issue in turning power quickly at a terminal, and as before stated, engines must be taken care of while out on the road and the engineman may be doing all he can to take good care of his engine and the fireman tearing down all the engineman is trying to hold up. With the heavy power we have nowadays with the wide and shallow fire-boxes, the firemen soon have a fire that they cannot see the flue sheet at all and the fire has gotten so high and heavy in the center that he is unable to shove it ahead and he then has lost his fire at the flue sheet, which then starts the flues to leaking and probably loosens them in the sheet and they will not take up again until worked in the shop. I do think that this heavy firing while on the road is the cause for so much flue trouble and so many failures. I do think that these classes of engines with the wide and shallow fire-boxes should be fired with a light fire and not have a fire to the crown sheet in the center of the fire-box and none at the flue sheet. The more leaks that develop on the road lessens the quick dispatching of power at a terminal and increases the cost.

G. W. KELLER,
Norfolk & Western Ry.
Portsmouth, Ohio.

TOPIC NO. 8.—WHICH IS THE CHEAPER TO MAINTAIN, THE PISTON OR SLIDE VALVE?

Much has been said on this subject of late, and unlike many other subjects, it grows in interest with each additional opinion and discussion. This fact shows conclusively that something can be said in favor of both the piston and the slide valve, regarding their economical use. However, my experience is that the more economical of the two is the piston valve, in proof of which I beg to call attention to the following facts:

(1) Cost of construction. Any mechanic will agree with me that the quantity of material in the piston valve is less than that in the slide valve, and also that it requires less work to make. Further, that it requires less time to apply the piston valve to an engine than it does the slide valve.

(2) Its cost to maintain is less than that of the slide valve because it is easier to apply new rings to the piston valve than to take down steam chest cover and apply new strips or springs, as the case may be, to the slide valve, and the ring in the piston valve is no more liable to break than the strip of spring in the slide valve. It is true that in case of the ring's breaking the engine blows as bad, if not worse, crippling the engine as quick or quicker, than the breaking of the strip or spring in the slide valve, depending on the size of the piece broken from the ring. However, valves properly put up and of good material, should last from the time an engine is shopped until she is again ready for shopping. We find this no uncommon thing. We have had to repair the slide valve on the cross-over compound as many as three times between the shoppings of the engine, while occasionally we have had to renew the piston valve on the simple engine even more than this, but I attribute the cause of the latter to the way the valve stem is put up at the factory. They are fastened to a crosshead valve stem going through the crosshead piston with a nut on each side of the crosshead and a little dowel pin to hold the valve in position. I think this a very poor arrangement for holding the valve in its proper place, as it is easy for the dowel pin to be put a little out of line one way or the other, which would throw the valve ring joint off the broad bridge, allowing the ends of the ring to strike the ports, and I consider this the cause of the rings breaking so frequently as they do. I think the valve stem should be fastened with a key, which would eliminate this trouble.

The piston valve operates on one-third less oil than the slide valve, due, I believe, to the fact that the piston valve is more perfectly balanced than the slide valve, hence less friction and less oil.

(3) Piston valve engines are smarter than slide valve engines. This is due to the fact that the valves are so perfectly balanced and they have a larger exhaust cavity, making the engine freer to relieve herself at the proper time.

B. A. BELAND,
Roundhouse Foreman, Frisco System.
Springfield, Mo.

The one hundred and twenty-second annual report of the General Society of Mechanics and Tradesmen of the City of New York has just been issued, and it is gratifying to observe that in the important branch of encouraging young men in acquiring a practical knowledge of some useful trade the society is doing excellent work. The evening classes, open from October until May of each year, furnish free instruction of a high order in every department of applied science by competent instructors. The classes are being constantly enlarged, and at the closing exercises in the Carnegie Lyceum last month, nearly one hundred diplomas and many valuable prizes were distributed to the graduating classes. The exhibits in architectural, mechanical and free hand drawing were particularly fine.

Items of Personal Interest

At the recent Convention of the American Railway Master Mechanics' Association held at Atlantic City, N. J., the following gentlemen were elected officers of the association of 1908-9: President, Mr. H. H. Vaughan, assistant to the vice-president of the Canadian Pacific Railway; first vice-president, Mr. Geo. W. Wildin, mechanical superintendent of the New York, New Haven & Hartford Railroad; second vice-president, Mr. C. E. Fuller, assistant superintendent of motive power and machinery of the Union Pacific Railroad; third vice-president, Mr. J. E. Muhlfeld, general superintendent of motive power of the Baltimore & Ohio Railroad; treasurer, Angus Sinclair, D. E., Editor of RAILWAY AND LOCOMOTIVE ENGINEERING, New York. The executive committee includes the officers above named and in addition the following gentlemen were elected: Mr. H. T. Bentley, assistant superintendent of motive power of the Chicago & North-Western Railway; Mr. T. Rumney, general mechanical superintendent of the Erie Railroad; Mr. T. H. Curtis, superintendent of machinery of the Louisville & Nashville Railroad. The other members of the committee elected at the 1907 Convention have, under the constitution, another year to serve. They are Mr. C. A. Seeley, mechanical engineer of the Chicago, Rock Island & Pacific Railroad; Mr. John Howard, superintendent of motive power of the New York Central Railroad; Mr. F. W. White, general mechanical engineer of the New York Central lines. The following officers of the Master Car Builders' Association were elected for the year 1908-9: President, Mr. R. F. McKenna, master car builder of the Delaware, Lackawanna & Western Railroad; first vice-president, Mr. F. H. Clark, general superintendent of motive power of the Chicago, Burlington & Quincy Railroad; second vice-president, Mr. T. H. Curtis, superintendent of machinery of the Louisville & Nashville Railroad; third vice-president, Mr. LeGrand Parish, superintendent of motive power of the Lake Shore & Michigan Southern Railway; treasurer, Mr. John Kirby, of the Lake Shore & Michigan Southern Railway. The executive committee consists of Mr. J. E. Muhlfeld, of the Baltimore & Ohio; Mr. C. E. Fuller, of the Union Pacific; Mr. H. D. Taylor, superintendent of motive power and machinery of the Philadelphia & Reading Railway; Mr. J. F. Walsh, superintendent of motive power of the Chesapeake & Ohio Railway, and Mr. C. A. Schroyer, superintendent car department Chicago & North-Western Railway.

At the recent convention of the International Railway General Foremen's Association held in Chicago, the following gentlemen were elected for the year 1908-9: President, Mr. E. F. Fay, general foreman Union Pacific Shops, Cheyenne, Wyo.; first vice-president, Mr. J. J. Houlihan, general foreman Wabash Railroad shops, Montpelier, Ohio; second vice-president, Mr. G. W. Keller, general foreman Norfolk & Western shops, Portsmouth, Ohio; third vice-president, Mr. C. H. Voges, general foreman Cleveland, Cincinnati, Chicago & St. Louis shops, Bellefontaine, Ohio; fourth vice-president, Mr. Thos. Zinda, general foreman, Cleveland, Cincinnati, Chicago & St. Louis shops at Delaware, Ohio; secretary-treasurer, Mr. E. C. Cook, Grand Central Pasesnger Station, Chicago.

Mr. O. M. Stimson, master car builder of the Swift Refrigerator Transportation Co., has resigned.

Mr. A. G. Faber has been appointed signal engineer on the Chicago, Rock Island & Pacific Railway, vice Mr. G. E. Ellis, resigned.

Mr. Frank B. Joynes has been appointed assistant master mechanic on the Georgetown & Western Railway, with headquarters at Georgetown, S. C.

Mr. N. J. Haynen has been appointed master mechanic on the Gulf & Ship Island Railway, with headquarters at Gulfport, Miss., vice Mr. A. Bardsley, resigned.

Mr. J. M. Marshall has been appointed superintendent of bridges and building on the Arkansas, Louisiana & Gulf Railway, with headquarters at Monroe, La.

Mr. G. W. Hedge has been appointed assistant master mechanic on the Canadian Northern, with headquarters at Winnipeg, Man., Can., vice G. S. McKinnon, deceased.

Mr. R. G. Kenly has been appointed engineer maintenance of way of the Lehigh Valley Railroad Company, with headquarters at So. Bethlehem, Pa., vice Mr. E. B. Ashby, promoted.

Mr. E. B. Ashby, formerly engineer of maintenance of way on the Lehigh Valley Railroad, has been appointed chief engineer on that road with offices at New York, vice W. G. Berg, deceased.

Mr. W. Byrd Page has been appointed assistant superintendent of machinery, of the Central of Mexico Railway with headquarters at Aguascalientes, Mex., vice Mr. C. H. Burk, resigned.

Mr. Harry Murray, of San Luis Potosi, Mexico, has been elected first grand assistant engineer of the Brotherhood of Locomotive Engineers, to succeed Mr. R. W. Botterell, of Ottawa, Ont., Canada.

Mr. W. J. Burton has been appointed division engineer of the St. Louis terminals of the Missouri Pacific, with headquarters at Seventh and Poplar streets, St. Louis, Mo., vice Mr. F. W. Bettle, transferred.

Mr. Arnold B. Hill has been appointed general agent, passenger department of the Lehigh Valley Railroad, with headquarters at 203 South Clark street, Chicago, Ill., vice Mr. Geo. Eade, Jr., deceased.

Mr. P. C. Hart until recently superintendent of terminals on the Chicago, Milwaukee & St. Paul, at Chicago, is now on construction work on the Pacific extension on that road, under the direction of the chief engineer.

Mr. B. R. Moore, formerly assistant superintendent of motive power of the Chicago, St. Paul, Minneapolis & Omaha Railway, has resigned his position with that company and is now at 502 N. 7th street, Kansas City, Kas.

Mr. C. H. Burke, assistant superintendent of machinery on the Mexican Railway at Aguascalientes, Aguas., has been appointed locomotive superintendent on the same road at Orizaba, Vera Cruz, vice Mr. W. Cockfield, resigned.

Mr. E. B. Fischer, general superintendent of the Missouri, Oklahoma & Gulf Railway, has been appointed purchasing agent on that road, succeeding Mr. G. H. Bacon. Mr. Fischer is now general superintendent and purchasing agent.

Mr. T. C. Hudson, formerly master mechanic of the Canadian and Northern Quebec Railroad at Shawinigan Falls, Quebec, has also been appointed master mechanic on the Quebec & Lake St. John Railway, vice Mr. J. Clark, resigned.

Mr. F. M. McNulty, formerly master mechanic on the Monongahela Connecting Railway, has been appointed superintendent of motive power and rolling stock and will also perform the duties of master car builder on the same road.

Mr. Frank C. Green has been elected

president of the Consolidated Car Heating & Lighting Co., in place of Mr. R. C. Pruyn, and Mr. Cornell S. Hawley became vice-president and general manager of that company in place of Mr. J. H. Manning.

Mr. B. B. Gordon, chief engineer on the Colorado Southern, New Orleans & Pacific, has resigned, and the position has been abolished. Mr. C. H. Fisk, chief engineer of maintenance of way, whose headquarters are at Beaumont, Tex., assumes the duties of Mr. Gordon's office.

Mr. E. Corrigan, of Hillsboro, Texas, has been chosen as assistant grand chief of the Brotherhood of Locomotive Engineers to fill the last of the two new positions of that title, which the convention created The office carries with it a salary of $3,500 a year, with travelling expenses.

Mr. Thomas C. Powell, vice-president of the Southern has succeeded the late W. J. Murphy as vice-president of the Cincinnati, New Orleans & Texas Pacific Railroad, which gives him authority over the operating and traffic departments of that road. Mr. Murphy's successor in the board is Mr. Fairfax Harrison.

Mr. R. M. Gauthier, formerly storekeeper on the Canadian Northern Quebec Railway at Shawinigan Junction, has been appointed storekeeper on the Quebec & Lake St. John Railway; vice, Mr. A. Hardy, resigned. Mr. Gauthier's new jurisdiction extends over both the C. N. Q. R. and the Q. & L. St. John Railway, with headquarters at Quebec.

Mr. E. E. Calvin, vice-president and general manager of the Southern Pacific Co., has issued a pass for conductors, engineers and agents or other employees, including their wives, good for one year, and upon which is stamped "For Meritorious Service." It is like the distinguished service order and its effect upon those who receive it is very marked.

Mr. W. J. Wilgus, formerly vice-president of the New York Central, is now president of the Amsterdam Corporation, which is a company recently formed for handling large engineering contracts and railway problems connected therewith. The vice-president of the company is Mr. H. J. Pierce of Buffalo, president of the International Railway Co. The headquarters are in New York.

The James Watt Memorial Building at Greenock, Scotland, which has just been erected on the site of the great inventor's birthplace from a fund subscribed by admirers all over the world, will shortly be dedicated as an engineering and naval school and entrusted to the school board of Greenock. A sum sufficient for the future maintenance will also be placed with the board to insure the perpetual maintenance of the building.

The H. W. Johns-Manville Co., of New York, announce the opening of a branch office in Indianapolis, Ind., to take care of the local requirements of their trade in that territory. This office, which is at 30 South Pennsylvania street, Indianapolis, is under the management of Mr. Charles E. Wehr, who, for several years, has represented the company in that section.

Mr. H. R. Charlton, advertising agent of the Grand Trunk Railway, recently returned to Montreal after a two months' stay in London, where his company has a building and exhibit at the Franco-British Exhibition. The architectural beauty of the Grand Trunk Railway building is greatly admired. On the panels of the walls in French and English are a series of statistics concerning the progress of the Dominion.

In our last month's issue we mentioned that Messrs. Jerome & Elliott had moved to No. 351-3 Monroe street, which is, of course, the fact, but the type-setting machine got out the words, "New York," while we weren't looking. This correction, while it is in order, is in a sense, hardly necessary, as the makers of the Jerome metallic packing are well known as a Chicago firm. 351 Monroe street, Chicago will find them.

The convention of the American Foundrymen's Association came to a close at the Exhibition Grounds, in Toronto, Can., a few weeks ago. The delegates unanimously chose as their next president Mr. Lawrence T. Anthes, superintendent of the Toronto Foundry Company. Mr. Anthes is the first Canadian and the youngest man who has yet held this position, which means that he is head of an Association composed of some of the leading iron and steel manufacturers of America. It was the acknowledged success of this Toronto convention that led to Mr. Anthes being nominated in recognition of his untiring work.

Our editor-in-chief, or as he used to be called by John Hill in the early days of Locomotive Engineering. the "Senior Philosopher," sails for the heathery hills of Scotland on July 4, and intends to make a brief stay in the British Isles. Dr. Sinclair will have an opportunity of noting the progress made on British railways, and will visit the scenes of his former labors on the good old Caledonian Railway. He will also visit his brother, Sir William Sinclair, at Manchester and will probably go over the famous St. Andrew's links with the driver, the cleek and the putter, before he returns to the editorial desk of RAILWAY AND LOCOMOTIVE ENGINEERING in New York.

Mr. Geo. H. Daniels, formerly general passenger agent of the New York Central, is reported to be seriously ill at his summer home at Lake Placid in the Adirondacks. Mr. Daniels has not been in good health for a long time. After his retirement from active service, he removed from New York to Buffalo. Rheumatism attacked him and compelled him to go to Hot Springs, Ark. We hope, however, that the air of the Adirondack Mountains will be beneficial.

The many friends of Dr. Charles H. Benjamin will be pleased to learn of the honor which was bestowed upon him at the recent commencement of the Case School of Applied Science, Cleveland, Ohio. At the close of the exercises, President Charles S. Howe, acting in accordance with the vote of the Faculty and by authority of the Board of Trustees, conferred upon him the honorary degree of Doctor of Engineering. The ceremony was very short and simple. Preceding the conferring of the degree, a short address was given by Professor C. F. Mabery, senior member of the Faculty, who spoke in regard to the work of Dr. Benjamin as an engineer, investigator, author and administrator. Dr. Charles H. Benjamin graduated from the University of Maine, 1881, receiving the degree of Mechanical Engineer. After graduation, he served his Alma Mater as a professor for a time, but finally took up engineering work in the commercial field. A few years later, he became Professor of Mechanical Engineering at the Case School of Applied Science, where he remained for a number of years. Last August, he was appointed Dean of the Schools of Engineering in Purdue University at La Fayette, Ind. Dr. Benjamin is a member of two college fraternities, the American Society of Mechanical Engineers and other national societies.

Mr. W. Sutherland Taylor, who has been treasurer of the Canadian Pacifis Railway since 1884, and who is now in his sixty-ninth year, has retired from his position. He will leave for England early in July on a holiday trip. He has been succeeded as treasurer of the company by Mr. H. E. suckling, who has been his assistant for twenty-two years. Mr. Taylor was born at Dornoch, Sutherlandshire, in 1839, and came to Canada in his early manhood. He was for a time secretary and treasurer of the Toronto, Grey & Bruce Railway, and left that office to become treasurer of the Canadian Pacific Railway, in 1884. Mr. Suckling succeeded Mr. Taylor as secretary and treasurer of the Toronto, Grey & Bruce, having previously been secretary-treasurer of the old Credit Valley Railway. These companies were many years ago absorbed by the C. P. R.

Obituary.

William H. Bouskill, an honored and highly respected locomotive engineer on the Canadian Pacific Railway, died from injuries received in a collision which recently took place near Owen Sound, Ont. The accident by which Mr. Bouskill met his death was a peculiarly distressing one. A freight engine left near the roundhouse after a trip by an incoming engineer began to move with no one on it. The runaway gained speed and on rounding a curve some miles from Owen Sound collided with the express from Toronto in charge of Engineer Bouskill. The fireman was severely injured and the mail clerk on the train was killed. Mr. Bouskill was over 60 years of age and had followed railroading all his life. He had many years ago been employed by the Credit Valley, but after that road was absorbed by the C. P. R. and for the last 25 years he had lived in Toronto, working on the T. G. and B. section of the Canadian Pacific. His long record as an engineer was a good one and death found him at the post of duty.

Joseph Clarke, one of the most widely known engineers on the Ontario and Quebec division of the Canadian Pacific died at his home in Elora, Ont., last May. He belonged to a thoroughgoing railroad family. Three of his brothers have engines on the Grand Trunk or the C. P. R. and three of his sons are in railroad employ. Mr. Clarke, who was in his 58th year, came to Toronto from Stockport, Eng., and took service with the Credit Valley Line, which then ran into Toronto. When the C. P. R. took over this line in 1883 Mr. Clarke went into the service of the big corporation and has remained with them ever since. For 27 years he has been on the passenger train between Elora and Cataract Jct. He was known on the road as a first-class mechanic and did all the running repairs on his own engine. For 40 years altogether Mr. Clarke has been engaged in railroad work, and for 35 of that 40 he has had an engine. His son, Roland, is train despatcher at Eau Claire, Wis.; Howard is station agent at Melrose, Man., and Percy is a telegraph operator at Warren, Wis.

Heavy 2-8-0 for the Southern.

The Pittsburgh Works of the American Locomotive Company have recently completed an order for four Consolidation engines for the Southern Railway, one of which is shown in our illustration. These engines are intended for the St. Louis and Louisville division and will be used in fast freight service. In working order they have a total weight of 190,500 lbs., of which 165,000 lbs. are carried on the driving wheels. The cylinders are 21 ins. in diameter by 28 ins. stroke and with a boiler pressure of 200 lbs. and driving wheels 63 ins. diameter, these engines will develop a maximum tractive power of 33,300 lbs. This with a weight on driving wheels as before stated, of 165,000 lbs., gives a factor of adhesion of nearly 5, which is somewhat higher than ordinary practice. The cylinders are equipped with balanced slide valves, having 1-inch steam lap and no exhaust lap or clearance.

SIMPLE 2—8—0 ENGINE FOR THE SOUTHERN RAILWAY.

A. Stewart, General Supt. of Motive Power and Equipment. American Loco. Co., Builders.

The valves have a maximum travel of 5½ ins. and are actuated by the Walschaerts valve gear. As the centers of the valve chambers are 3 ins. outside the centers of the cylinders, the motion of the eccentrics is transmitted direct to the valve stem without the use of rocker arms. The link is carried in a bracket bolted to the back of the guide yoke, to which the reversing shaft bearing is also bolted; the radius rod being connected with the backward extending arm of the reverse shaft by means of a link. As the valve is outside admission the radius bar connection with the combination lever is below the valve stem. The wheel base of this engine is 25 ft. 6 ins. in all, while the driving wheel base is 17 ft. With the tender the entire wheel base is 57 ft. 8¾ ins.

The boiler is of the radial stayed straight top type and has an outside diameter at the first ring of 70 ins. It contains 295 tubes 2 ins. outside diameter and 15 ft. 6½ ins. long. The total heating surface is 2546.3 sq. ft., of which the tubes contribute 2387.7 sq. ft. and the firebox the remainder. The firebox is 107 ins. long and 71½ ins. wide, with sloping back head and throat sheet. It provides a grate area of 54 sq. ft. This gives one sq. ft. of grate area for every 47 sq. ft. of heating surface, which is a greater proportion of grate area than is usual in this class of engine. The large proportion of grate area to heating surface is due to the fact that in order to obtain large water spaces between the tubes, a smaller number of tubes have been provided than is the usual practice in a boiler of this size. In ordinary practice from 11/16 to ¾ ins. spaces between tubes are provided, but in this design the tubes are spaced 2⅞ ins. between centers, giving a water space of ⅞ ins.

The engine is equipped with a Westinghouse 9½-inch air pump, placed on the left side and the main reservoir is made in the form of two cylinders, each 16x140 ins. The tender frame is composed of structural steel channels 12 ins. deep. The tank contains 7,500 gallons of water and 12½ tons of coal.

A few of the principal ratios involved in this design, together with some of the dimensions are here appended for reference.

		P. C.
Weight on drivers divided by total weight	=	86
Weight on drivers divided by tractive effort	=	4.95
Total weight divided by tractive effort	=	5.72
Tractive effort x diam. drivers divided by heating surface	=	823
Total heating surface divided by grate area	=	47.1
Firebox heating surface divided by total heating surface	=	6
Total weight divided by total heating surface	=	65
Volume both cylinders cu. ft.	=	11.20
Total heating surface divided by vol. cylinders	=	217.3
Great area divided by vol. cylinders	=	4.82

Weight—Working order engine and tender, 332,710 lbs.

Axles—Driving journals, main, 9½ ins. by 11 ins.; others, 9 ins. by 11 ins.; engine truck journals, diameter, 5½ ins.; length, 10 ins.; tender truck journals, diameter, 5½ ins. by 10 ins.

Firebox—Length, 107 ins.; width, 71¼ ins.; thickness of crown, ⅜ in.; tube, ½ in.; sides, ⅜ in.; back, ⅜ in.; water space, front, 4½ ins.; sides, 4½ ins.; back, 4 ins.

Driving Boxes—Cast steel.

Piston—Rod diameter, 3¾ ins.; piston packing, snap rings.

Smokestack—Diameter, 17 ins.; top above rail, 15.04¼ ins.

Valves—16 ins.; type, Richardson.

Wheels—Centre material, cast steel; engine truck, diameter, 33 ins.; tender, 33 ins.; cast iron.

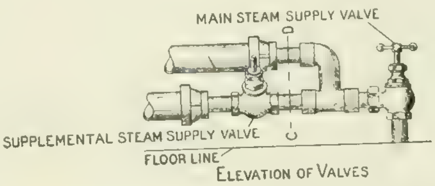
Regulating Direct Steam Heat.

The Safety Car Heating & Lighting Company have developed their Regulating System of Direct Steam Heating in order to produce a steam heating system which is capable of easy adjustment, capable of meeting the varying conditions of outside temperature, and, while avoiding the overheating of cars in mild weather, still insures adequate heat during extremely cold weather. The method adopted by this company is an arrangement of the pipe system so that the amount of radiating pipe in service may be varied at will. It is not possible to secure this result by maintaining a constant radiating surface with varying the steam pressure. There is not sufficient difference in the ability to heat the surrounding air between a pipe containing steam at say 45 lbs. (290 degs. Fahr.) and one at 2 lbs. pressure (218 degs. Fahr.). This is a possible range of temperature of 72 degs., or 25 per cent.

In the "Regulating System" there is a total of four radiating pipes running the length of the car, two being located on each side of the car, and each pipe being supplied with independent admission valve and automatic trap for removing the water of condensation. It is thus possible to use either one, two, three or four pipes, at a time; or, considering four pipes as the maximum, to reduce the heating effect either 25, 50, or 75 per cent., as may be desired.

By reference to our illustrations it will be seen that steam is taken from the train pipe by means of a cross, passing through a 1 in. pipe to the admission valves or opposite sides of the car. When both valves are opened wide, steam will enter both the upper and lower pipes of the system, and the maximum heating effect will be obtained. The valve which controls the lower pipe is arranged to be operated by a key or wrench, the object being to keep this valve closed the greater part of the time, thus avoiding overheating the car. This will also assist in preventing the rear cars from being robbed of steam when first heating up long trains. In very cold weather, however, if more radiating surface is desired, the supplemental steam supply is opened on either one or both sides of the car.

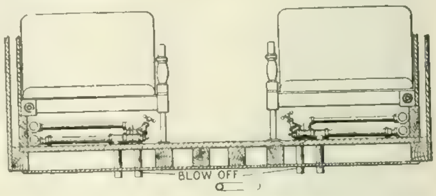
The "Regulating System" will not only result in a saving in steam consumption while the car is in actual service, but will also reduce the cost of keeping cars warm at terminals and



VALVES CONTROLLING SUPPLY.

yards, as ordinarily a car which is not moving and whose doors, windows and ventilators are closed, may be kept sufficiently warmed by the use of but one of the four radiating pipes, with a consequent saving in the amount of steam consumed.

By reference to the floor plan illustration, it will be seen that at a point about two-thirds the length of the car from the steam inlet, a special tee is placed in each radiating pipe. This tee is cast with a vertical web or wall in which are two openings, one tapped with ¾-in. pipe thread and the other being a small hole for the purpose of facilitating drainage. A ¾-in. pipe which is screwed into the larger opening lies along the bottom of the 2-in. radiating pipe and extends to the coupling a few feet from the end of the 2-in. pipe. One-inch pipes connect these special tees on each side of the car with the fitting, in which are incorporated a blow-off valve and two horizontal traps, and constructed in such a manner that each of the 1-in. pipes is independently connected through a



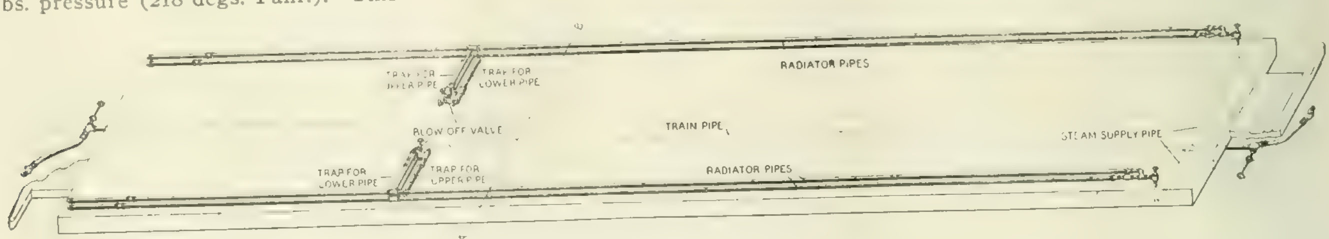
CROSS SECTION OF CAR.

separate passages with its corresponding trap. The blow-off valve is so arranged that is may be used to operate both the upper and lower pipes. Into the outlet of each trap and of the blow-off valve is screwed a 1½-in. drain pipe, passing down through the car floor.

In order to understand the operation of this system, suppose all valves to be closed. Now, if either of the main supply valves be opened, steam will enter and pass along the upper 2-in. radiating pipe on one side of the car until it reaches the special tee. It will then pass through the ¾-in. pipe (which is introduced to prevent air being pocketed in the dead end of the radiator), expand and fill the remainder of the 2-in. pipe, and pass through the 1-in. connection to the inlet of one of the automatic traps. When the car is first put in service, this trap is opened wide and steam allowed to blow through it until it is thoroughly hot. It is then closed by turning up the projecting stem with a key or wrench and permanently securing it by means of a locknut. Thereafter the trap requires no further adjustment, as it is then automatic in its action.

The traps are adjusted and the entire system operated from within the car, making it unnecessary to get under the car for any purpose. The operation of each of the other three radiating pipes is, of course, identical with that of the one referred to above, and any of the radiators may be turned on or off at will without the necessity of touching the traps or blow-off valves in any way.

On account of the traps being whol-



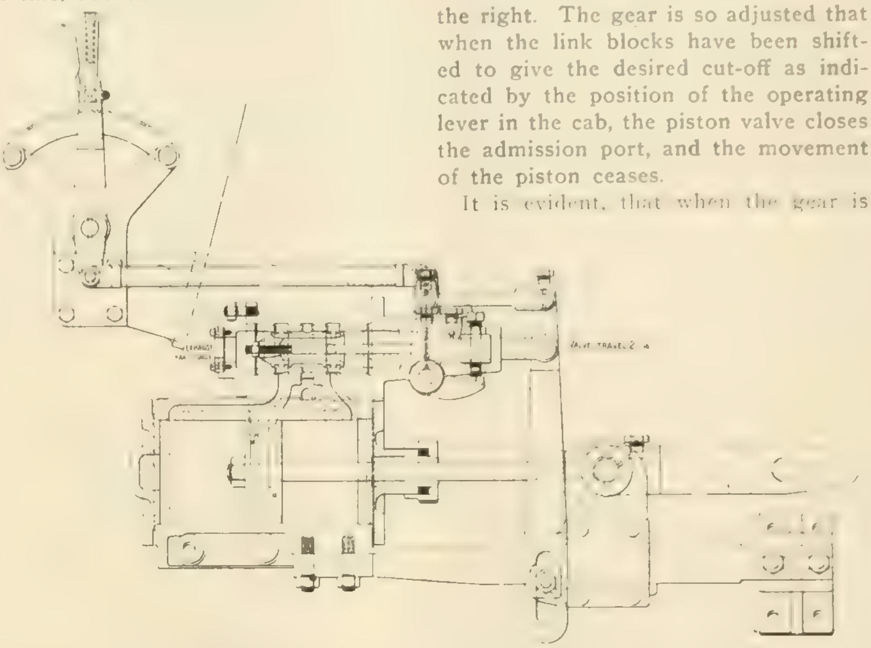
FLOOR PLAN OF CAR WITH DIRECT STEAM HEAT.

ly within the car, it is practically impossible for them to freeze; but even should either of them become frozen after steam has been cut off from the car, it could still be readily thawed out by simply turning steam on the remaining pipes.

Air Reversing Gear.

The Baldwin Locomotive Works have recently equipped one of the engines built at their shops with an air operated, reversing gear, which makes control of heavy valve motion a very easy matter. The engine in the case is none other than No. 1918, a Mallet compound belonging to the Great Northern.

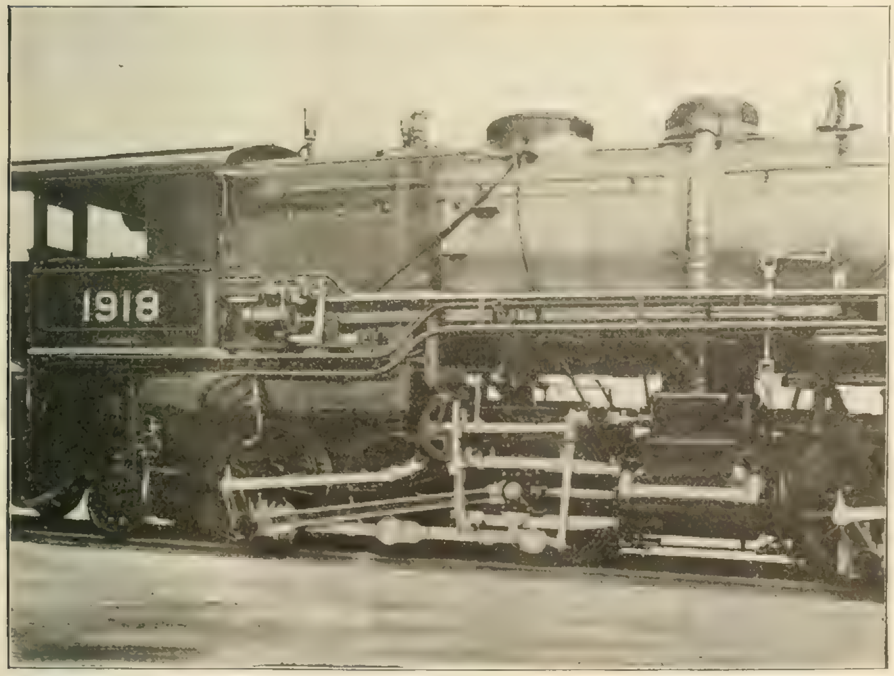
Application has been made for a patent covering this device. The air cylinder is bolted to the side of the firebox, immediately in front of the cab. Distribution of air is controlled by an inside admission piston valve, 3 ins. in diameter, which works in a cast iron bushing provided with suitable ports. The piston of the air cylinder is directly connected to a crosshead, which is coupled to the reversing shaft by means of a suitable link. The crosshead has a cast-steel body and cast-iron gibs, and slides on a single guide bar. The gibs are held in place by a wrought-iron plate, which carries a projecting stud. This stud engages in a slot which is placed in the lower end of a combining lever. The upper end of the combining lever is connected, by means of a rocker and suitable links, with the operating lever in the cab. The stem of the piston valve is also connected with the combining lever, a short distance below the previously mentioned connection to the operating lever. The rocker is provided with safety arms which strike adjustable set screws when the limit of travel of the piston valve, on either side of the center line, has been reached.



BALDWIN AIR OPERATED REVERSING GEAR.

The operating lever in the cab is locked in place by a toothed sector. When this lever is in its central position, as shown in our line illustration, the combining lever stands vertical and the piston valve covers both admission ports. When the operating lever is moved into forward gear, to the right, looking at the drawing, the combining lever swings about the crosshead stud as a fulcrum and the piston valve is moved to the left, thus admitting air to the rear end of the cylinder. A forward movement of the piston follows; the combining lever then swings about its upper end as a fulcrum, thus moving the piston valve to the right. The gear is so adjusted that when the link blocks have been shifted to give the desired cut-off as indicated by the position of the operating lever in the cab, the piston valve closes the admission port, and the movement of the piston ceases.

It is evident, that when the gear is set for any particular point of cut-off, the piston valve is in its middle position, and a slight movement of the combining lever will shift the valve a distance equal to its inside lap, 1/32 in., and admit air to the cylinder, thus locking the mechanism. In other words, after the air has been shut off, a further movement of the valve of only 1/16 in. will open the port leading to the opposite end of the cylinder and thus lock the gear.



BALDWIN AIR REVERSING GEAR ON GREAT NORTHERN MALLET.

One of the incidents of the annual ball connected with the Master Car Builders and Master Mechanics' Conventions which gave much amusement to those attending the assembly has suddenly grown into desuetude. This was the dancing of the Virginia Reel. When Frank Barbey and other young men of sense looked after the amusements of the Conventions, they made special efforts to induce the older members and visitors to take part in the Virginia Reel, and it always proved a most popular dance. The assortment of imbecile dudes who manage the ball now have done their best with success to suppress the old people's dance.

It is well know that the awkward people who try to swim at bathing resorts and incidentally swallow much salt water receive the greatest benefit from bathing. They imagine that the cool salt water is productive of health, but the salt water they swallow is of more benefit than the outside treatment.

Convention Exhibits.

The exhibits at the Atlantic City convention of the M. C. B. and M. M. Association this year surpassed anything that had previously been brought together by the Railway Supply Manufacturers' Association, and the whole formed a presentation of railroad appliances which was an object lesson of the most valuable and interesting character. The attendance of members was better than last year, the total number of registrations being ten per cent. greater than in 1907, and the floor space actually used for exhibits, which, of course, does not include the wide aisles and passageways provided, was seven per cent. greater than that occupied last year. The conventions were a great success in every way. Some of the exhibits were as follows.

American Balance Valve Co., Jersey Shore, Pa. A striking feature of this company's exhibit was a beautifully made model of the Walschaerts valve gear. There was also a model of the modified Stevens gear operating a Jack Wilson double acting admission valve. The exhibit consisted of balanced semi-plug piston valves, balanced high pressure slide-valves, balanced semi-plug valves arranged to suit Baldwin compound engines. Various other models were also shown.

American Brake Shoe & Foundry Co., Mahwah, N. J., had on view a large number of steel back car, coach and locomotive brake shoes, which formed an interesting bit of evidence of the variety of styles made by this company to suit all sorts of conditions. Brake shoes for heavy electric railway service were also exhibited.

The American Vanadium Co., of Pittsburgh, Pa., had an extensive and most interesting collection of the ores of vanadium. Bars of vanadium steel of all types and sizes, springs made of vanadium steel for engine and tender trucks, driving springs, axles, crankshafts, lathe tools, pneumatic hammer rivet dies, locomotive driving tires, locomotive frames, solid vanadium steel wheels and many other articles made from this fine grade of steel.

The Anchor Packing Co., of Philadelphia, had an interesting display of metal and fibrous packings for railway use.

The Armstrong Brothers Tool Company, of Chicago, Ill. "The tool holder people" had a splendid exhibit of all sorts of tool holders, the variety of which is truly wonderful. Among the many shown were the kind that appeals to the railroad man very convincingly. There were tool holders for lathes, slotters, shapers, planers; ratchet drills, lathe tools, and dogs, planer jacks and drill press vises, and many other handy devices.

The Bettendorf Axle Co., of Davenport, Ia., had an exhibit which attracted a great deal of attention. In a convenient portion of the pier and in good light was a completely equipped 100,000-lb. steel box car made by this company. The car was equipped with the Bettendorf single I-beam centre sill with cast steel ends. The car was mounted on the Bettendorf steel truck in which axle boxes and frames are all one. Another Bettendorf car was also in evidence. This was the 40-ft. all steel drop bottom gondola which was fully illustrated and described in our June issue on page 264. A Bettendorf single centre sill 36 ft., 30 ton steel stock car under frame equipped with Bettendorf swing motion trucks, and several examples of the Bettendorf car trucks and bolsters.

F. S. Bowser & Co., of Fort Wayne, Ind., had a complete line of oil pumps, tanks, etc., which exemplified the Bowser system of oil storage. Self-measuring oil pumps, which we have ventured to describe as a practical example of the "square deal" idea as applied to issuing oil for locomotives and cars. There were also long distance pumps where the supply was a considerable distance away, power pumps, adjustable measure cabinets, tanks and pumps suitable for machine shops, paint shops, round houses, engine rooms, storerooms, and in short everything for holding and delivering oil for railroad use.

The Buffalo Brake Beam Co., of New York, displayed a series of all steel brake beams made by them. These were equipped with forged steel brake heads, cleverly designed and easily applied, forged fulcrums, forged wheel guards, safety brake beam hangers, forged chain clips and steel back brake shoes.

The Butler Drawbar Attachment Co., of Cleveland, Ohio, exhibited their attachment as used in a variety of ways. They showed the Butler attachment with the Piper friction drawgear with standard springs and the Piper friction gear having special springs. Tandem gear with 6¼ x 8 in. springs applied to wooden underframe. Tandem drawgear attached to steel underframe with 8 x 8 in. springs.

The Carborundum Co., of Niagara Falls, N. Y. This exhibit has each year almost the fascination of a new discovery. The display consisted of crystals of carborundum in various forms; the beautiful irridescent colors of the many facets of the crystals never fail to strike the beholder with delight. Beauty of color here, however, goes with the highest degree of utility. Carborundum crystals are used in the well known carborundum grinding wheels and for sharpening stones all applicable and useful in the railroad repair and machine shop.

The Chicago Car Heating Co., of Chi-

cago, Ill., had an exhibit showing their Vapor system and their pressure system of car heating, also steam hose couplers, steam traps, train pipe valves, and various hot water specialties.

The Chicago Pneumatic Tool Co., of Chicago, had a very full and complete line of their numerous and varied products on view. Among them were the well known Little Giant, the Boyer and Keller drills, reamers, wood boring machines, flue rolling machines. A compound belt driven air compressor with its mechanically and therefore positively operated inlet valves. Boyer and Keller pneumatic riveting, chipping, and caulking hammers. Electric drills, for alternating or direct current blowers, grinders, railroad shop hoists, and vacuum cleaners for railroads, hotels and residences.

The Cleveland Car Specialty Co., of Cleveland, Ohio, showed an interesting assortment of their pressed steel carlines, some suitable for inside and outside car roofs, also pressed steel window forms suitable for baggage, express and passenger cars with curved windows. Pressed steel passenger coach side posts and window posts for the same and pressed steel lower deck roof supports for use in passenger cars.

The Central Railroad of New Jersey exhibited their new air brake instruction car, which had recently been built from designs made by Mr. B. P. Flory, mechanical engineer of the road, and Mr. G. W. Rink, chief draughtsman, under the supervision of Mr. Wm. McIntosh, superintendent of the road, and president of the Master Mechanics' Association for 1907-8. This car was illustrated and described in our March, 1908, issue, page 111.

The Commercial Acetylene Co., of New York, had a very interesting display, showing their safety storage system of acetylene as applied to car lighting. They also showed locomotive head-lights, signal lamps, etc. The safety system consists in filling a tank with porous asbestos. This asbestos has about 80 per cent. porosity, or in other words the tank appears to be completely full of asbestos while only ⅕ of the entire volume is occupied by the asbestos. This porous asbestos is saturated with a liquid called acetone and this has the property of being able to dissolve about 23 times its own volume of acetylene at a temperature of 62 degrees F. Acetylene gas, when dissolved in the acetone, is non-explosive. Sections of these tanks were exhibited and the various car fixtures supplied by this company were also displayed. The whole exhibit was most interesting, as in the evening all the lamps installed by the company were lighted and the effect was illuminating in more senses than one. The variety of globes, brackets, hanging lights, was such as to leave nothing to be desired. An acetylene cigar lighter also attracted considerable attention and lit up a great many cigars, and the operation lit up the faces of those who used it, with pleasure.

The Commonwealth Steel Co., of St. Louis, Mo. This company had as an exhibit an excellent display of all sorts of steel castings made by them, truck bolsters, truck center frames, etc., and they had on the exhibit track a cast steel tender frame made in one piece. It was altogether a very interesting exhibit and showed the advance made in the art of making steel castings for railroad use up to the present time.

The Consolidated Railway Electric Lighting & Equipment Co., of New York. The exhibit of this company consisted of a passenger car truck equipped with the consolidated axle light dynamo which furnishes electric current for lighting the cars while the train is in motion. The over-plus of electric energy is used to charge a storage battery, which battery is gradually called into action for lighting train as the speed diminishes, and also while the train is standing. The whole of this system, with its apparatus, was on view, together with the Kennedy regulator and indicating and recording attachment.

The John Davis Co., of Chicago, showed a number of back pressure valves, pump regulators, float valves, regulating valves for water and for air, blow-off valves, valves for steam hose couplings, etc.

The Detroit Lubricator Co., of Detroit, Mich., had on exhibition their well known bullseye lubricators, for from one to seven feeds. There was also a section of their 21-feed lubricator and a section of an air cylinder lubricator device, whereby the air cylinder of a Westinghouse or of a New York duplex air pump may be regulated directly from the cab. Packless radiator valves were also shown.

The Joseph Dixon Crucible Co., of Jersey City, N. J. This well known company had an interesting selection of their pencils on view, blacklead plumbago, graphite lubricants, graphite paint, crucibles of all kinds, and what they call automobile grease. The display was carefully arranged and many were the requests for their excellent pencils which this company received at their booth.

The Dressel Railway Lamp Works, of New York. This company had a remarkably fine display of locomotive head-lights, tail marker lamps, locomotive gauge lamps, head-light burners, locomotive classification lamps, switch lamps, semaphore signal lamps, etc. There is nothing in the way of railway lamps that the Dressel Works do not seem to handle. One of the new features of their railroad lamps was an exceedingly clever device which prevents a colored lens when once displayed from being shaken down and

altered for another color. The main lens of the lamps are made of white glass after the ordinary semaphore lens pattern, and inside the lamp there is carried a green and red glass which can be dropped down and interposed between the flame of the lamp and the white lens outside. This enables the lamp to show a white, a red, or a green color, as occasion may require. The safety device consists of a little metal frame pivoted at one end and so arranged as to accommodate only one of the arms attached to the colored glasses. When the red light is shown, the arm attached to the red glass occupies the slot to the exclusion of the green, and when the green is shown there is no possibility for the red to interefere with it. The device is exceedingly simple and most effective, as wrong indications cannot be given where this simple but cleverly devised apparatus is used.

The Falls Hollow Staybolt Co., of Cuyahoga Falls, Ohio. At this company's exhibit were to be seen the hollow and the solid staybolt iron made by them. The quality of the metal and its fibrous nature were exemplified by numerous samples bent and broken so as to display the interior structure. Samples of staybolt iron were shown doubled flat on themselves without fracture and other pieces had been hammered flat endways. The exhibition constituted, one might almost say, a bird's-eye view of the quality and kind of iron made by this company, which is not only used widely in this country, but is extensively used abroad.

The Flannery Bolt Co., Pittsburgh, Pa. The well-known Tate flexible staybolts were shown here, together with the tools necessary for applying them to locomotive fire-boxes. The company had also on display an extensive photographic record of their flexible staybolts, in some cases covering the danger zone and in others the whole side and throat sheets of the fire-box. These bolts are being very extensively used.

The Franklin Manufacturing Co., of Franklin, Pa. In this exhibit were shown the Curtis asbestos smoke jacks, corrugated asbestos, roofing and siding, asbestos building lumber and shingles, together with the asbestos steam pipe covering, wool-felt pipe coverings, asbestos rope and wick packings and asbestos cement. Ambler asbestos ring air pump and throttle packing, also their 85 per cent. magnesia boiler laggings.

The Franklin Railway Supply Co., of Franklin, Pa. This company exhibited their pneumatic fire door, their automatic driving-box lubricator, the McLaughlin metal flexible conduit and the Franklin automatic connector and the Franklin hydraulic jack. They also showed the Miser-Shaff water gauge. The Terry grease plug, the O'Connor fire-door flange and the Franklin grate shaker.

The Frost Railway Supply Company, of Detroit, Mich., had on exhibition the various sizes of Harvey friction draw springs, also the Detroit metal strips for coach windows and various models showing the application of the company's products for railroad work.

The Galena Signal Oil Co., Franklin, Pa. This company had what might be called a reception room rather than an exhibit of their well known products. The booth was most artistically furnished with antique chairs, tables and settees and the walls were hung with elegant and costly tapestries. Their many friends were received by a corps of representatives and it is safe to say that the reception parlor of the Galena Company formed a pleasant resting place for the many visitors and sightseers at the Convention.

The Garlock Packing Co., of Chicago. This company had on view a full line of metal and fibrous packings for locomotives and for shop machinery. The display was tastefully arranged and a sample of the many varieties of their products was thus brought comprehensively before the visitors.

The General Compressed Air & Vacuum Machinery Co., of St. Louis, Mo. This company exhibited a pneumatic railroad car cleaning truck with automatic control valve, and a complete set of tools and fittings necessary to do the work of rapidly and effectively cleaning coaches at railroad terminal yards. The truck can be taken about from place to place and attached to the ordinary compressed air system which is usually found in railroad yards for charging and testing brakes. With this device the compressed air system of the yard can be readily utilized for cleaning the plush cushions and carpets of the cars.

The General Electric Company, of Schenectady, N. Y. This company had on exhibition several railway motors, and among them was the G. E. No. 205, which was designed for the subaqueous tunnel at Detroit and the line of the Michigan Central. They also displayed a locomotive head-light set, run by a small Curtis turbine, which is usually carried on the top of the locomotive boiler in front of the dome. A 20-K. W. train lighting set was also shown together with a number tantalum lamps, switch panels, etc., for car lighting. The application of other motors for various tools used in railway repair shops was shown and also a universal saw bench, band saw and lathe.

The General Railway Supply Co., of Chicago, Ill. This company had a very interesting exhibit showing the steel car sheathing which they manufacture, also a National steel trap door and lifting device for passenger coaches. The Schroyer friction curtain rollers and curtains for passenger cars, also Garland ventilators, National standard roofing, Flexolith com-

position flooring, Ideal Roller center bearings and the National automatic vestibule curtain catchers.

The Gold Car Heating & Lighting Co., of New York, had a very extensive and complete exhibit showing their well known system of car heating and lighting. The numerous improvements and devices which this company has got out from time to time and with which our readers have become familiar were there shown as they would be applied in regular service. The exhibit practically formed a demonstration of the Gold system.

Gould Coupler Co, of New York, displayed a number of Gould couplers, malleable iron journal boxes, side-unlock coupler, Moritz M. C. B. couplers, Gould friction draw gears, cast-steel journal box, special malleable iron draw rigging and striking plates, Crown truck side frame with Crown bolster, also Gould journal boxes, Gould steel passenger platform with friction buffer, Gould special electric locomotive coupler, Hartman ball bearing center plates, Hartman side bearings, frame with Gould body bolster, Gould freight coupler, new passenger coupler, rightning device and Gould vestibule.

Greene, Tweed & Co., New York, had on exhibition their Palmetto packing for locomotive air pumps. Palmetto braided and twist packing. The Palmetto air pump packing is made suitable for Westinghouse, and for N. Y. duplex pumps. They also showed their Favorite reversible ratchet wrench.

Hunt-Spiller Manufacturing Corporation, South Boston, Mass. Various locomotive parts made out of gun iron were displayed in this exhibit, such as driving boxes, driving shoes and wedges, pistons, cylinder bushings, piston packing, headers for superheaters, piston valve cages, piston valve packing rings, false valve seats, eccentrics, straps, crosshead gibs, etc.

Independent Pneumatic Tool Co., Chicago, had a fine assortment of air drills, reaming, tapping and portable pneumatic grinding machines, pneumatic reversible flue rolling and wood boring machines, one-piece pneumatic long stroke riveting hammers, pneumatic chipping, calking, beading and scaling hammers, pneumatic wood saws, close quarter piston air drills, air hose and couplings, pneumatic holding-on device, motorcycles and other devices.

Jenkins Bros., of New York. This concern had a remarkably complete exhibit of Jenkins valves, consisting of globe, angle, check, cross, radiator and gate valves. The Jenkins Bros.' patent gauge cocks, diamond traps, automatic air valves and the Jenkins '96 sheet packing. There was also shown the Sellers restarting injectors, Jenkins pump valves, Graber indicating automatic water gauges, Prouty Wire valve wheels, together with the Jenkins gasket tubeing.

H. W. Johns-Manville Co., of New York. This company's exhibit included asbestos and magnesia railroad supplies among which may be mentioned their 85 per cent. magnesia locomotive boiler lagging and pipe covering, asbestos and rubber packing for many and various uses, asbestos cement, asbestos wood, Transite lumber, asbestos roofing, asbestos mill board and fire felt sheets, Phoenix smoke-jacks, electric fuses, blocks and switches, magic boiler compound. Morris metallic packing. A very neat arrangement of brake cylinder packing was also shown by this company. The ordinary spring ring packing is made out of round steel wire, the Johns-Mansville ring is flat, thereby insuring a greater bearing surface of leather against the walls of the air brake cylinder. The ring is split on the bevel like an ordinary piston packing ring and is easy to apply and to remove. The life of the leather packing is said to be greatly increased thereby.

Lawrenceville Bronze Co., of Pittsburgh, Pa. Among the very many interesting articles displayed was their Corinthian bronze driving boxes, Robertson blow-off valves, McGillivray hydraulic valves, rod brasses, journal bearings, etc., bevel wheel and shafting, three-way tuyere air cock. There was also on view a large assortment of unions, bevel wheels, pinions, etc.

Locomotive Appliance Co., of Chicago. This company had a full sized Alfree patent slide valve on a locomotive cylinder as used in connection with their valve gear. Also a number of Newton wrecking frogs.

McCord and Company, of Chicago. In this exhibit the well-known McCord journal box was in evidence, also the McCord draw gear and the McCord spring dampner. There was also shown the National equalizing wedge and the McKim gasket. One of the most interesting features of this exhibit was the McCord force feed lubricator as applied to locomotives. This device was set up on a large frame and was operated in the same way as it would be from the crosshead of a locomotive. All the parts were clearly shown and one comprehensive glance at this device thus put the whole mechanism before the eye of the beholder.

Michigan Lubricator Co., of Detroit, Mich. This display included the Bullseye locomotive lubricators of the 2, 3, 4 and 5 feed type, also the Michigan by-pass lubricator, their air pump lubricator, their automatic drain valves for locomotives whereby, by the use of a small metallic ball which sinks in water and floats in oil, the water of condensation may be drawn off without the loss of a single drop of oil. Michigan stationary engine and compressor lubricators were also shown.

Modoc Soap Co., of Philadelphia, had an interesting display of their "Perfectol"

car, locomotive and signal blade cleaner. Also their Perfectol metal polish and Perfectol renovator for use in the interior of railroad coaches.

The McConway & Torley Co., of Pittsburg, Pa., had on exhibition at the M. C. B. and M. M. Convention at Atlantic City last June, various types of couplers manufactured by them. Among them was a new modification of the Janney Coupler, which has been designated as the "Janney X." In this coupler they have embodied with the simplicity of the original Janney Coupler with vertical locking pin the up-to-date requirements of a "Lock-to-the-Lock," providing effectually against any creeping of the lock or accidental uncoupling, a "Lock-Set" making it unnecessary to lock up the uncoupling lever on the end of the car in shifting, and a "Knuckle-Opener," complying with the requirements of the M. C. B. Association as to the functions desirable in an automatic coupler. The M. C. B. specification of a "Knuckle-Opener" requires one "which will throw the knuckle completely open and operate under all conditions of wear and service," and in the "Janney X" coupler this has been accomplished, as the knuckle-opener opens the knuckle to its fullest range of movement from either a fully closed position or from any partially open position. The old style of Janney Coupler has always been popular with the trainmen on account of its simplicity, and this desirable characteristic has been preserved in this new design.

The Nathan Mfg. Co., of New York, exhibited a full line of their well-known injectors, lubricators and boiler appliances. The exhibit was tastefully arranged and was much admired.

The National-Acme Mfg. Co., of Cleveland, Ohio, showed their automatic multiple spindle screw machines, one with single belt drive and the other with independent motor. These machines are wonderfully efficient and were much admired.

The National Boiler Washing Co., of Chicago, had an exhibit which showed their boiler washing appliances. Flexible copper tubing, blow-off valves and the Atlas side bearing were on view.

The National Malleable Castings Co., of Cleveland, Ohio, showed a variety of car couplers, which were the Tower, the Climax and the Vulcan. Both National and Climax journal boxes and other railroad specialities were shown. The couplers and other articles exhibited were mounted for easy inspection.

The Pressed Steel Car Co., of Pittsburgh, Pa., had on the convention exhibit track a very beautifully fitted all steel passenger coach. The car was elegantly and tastefully though plainly furnished and the imitation of wooden arm rests for the seats was perfect. The window sashes appeared to be the only thing which were not made of steel in these cars.

Ralston Car Co., of Columbus, exhibited models of steel underframe car construction. On the exhibit track they had a gondola dump car of 100,000 lbs. capacity and a box and stock car of 80,000 lbs. capacity.

The Safety Car Heating & Lighting Co., of New York, had an extensive and interesting exhibit showing all their apparatus for the safe heating and lighting of passenger coaches, by the Pintsch system. Both mantle and flat flame lamps were shown. The vapor system of lighting and the axle light were seen in operation. Their steam heating systems were also shown; these were the jacket and the new direct steam regulating systems, which is illustrated and described in greater detail in another column of this issue. All the appurtenances and accessories of these systems were on view, and a large corps of skilled representatives were on hand to explain and demonstrate the use and working of the various devices.

The St. Louis Car Co., of St. Louis, had an exhibit comprising car seats, rattan goods and spiral journal bearings for railway cars.

William Sellers & Co., Inc., of Philadelphia, had what may be called a working exhibit of tool and drill grinding and shaping machines. Their 1908 non-lifting injector, attached to which was an automatic lazy cock. A very interesting part of the exhibit consisted of models made in section, showing their locomotive and stationary boiler injectors, check valves, strainers, etc.

The Standard Car Truck Co., of Chicago, exhibited a couple of trucks, one for tenders and one for freight cars. Roller bearing center plates were also shown, together with several truck models showing their double action, and other forms of trucks.

The Standard Coupler Co., of New York, maintained a very attractive reception booth, which was always well filled with visitors.

The Standard Paint Co., of New York, showed their Rubberoid car roofing, which is applicable also for buildings of all kinds. Rubberoid is very effective on refrigerator cars and wherever cold storage is required. The company had also examples of their preservative paints for iron and wood, and their insulating varnishes. The whole exhibit was tastefully grouped and made an exceedingly interesting display.

The Stoever Foundry & Mfg. Co., of

Lebanon, Pa., had on exhibition their 3-in. motor driven pipe threading machine.

The Storrs Mica Co., of Oswego, N. Y., gave an object lesson on the heat resisting qualities of their mica lamp chimneys by having a number of small mica chimneys mounted on incandescent gas lamps. Their well-known "Never Break" mica headlight and caboose lamp chimneys were exhibited.

The T. H. Symington Co., of Baltimore, Md., displayed the axle boxes bearing the company name. Side-bearing and center plates with the bearings were exhibited and various malleable iron car castings were to be seen. Locomotive castings made of "refined iron" formed part of an extremely interesting and well handled exhibit.

H. B. Underwood & Co., of Philadelphia, had a good exhibit of their various portable shop tools and appliances, among which were their rotary planing machine for valve seats on locomotives, their portable frame pedestal planer, a description of which was given in Railway and Locomotive Engineering last April, page 177. Their new design of crank pin turner and reborer, capable of use by hand or driven by power. Their standard portable boring bars for locomotive cylinders. Their portable pipe bending machine and their two-cylinder air or steam motor for driving these handy portable appliances.

The Ward Equipment Co., of New York, had an extensive exhibit of heating apparatus for railway cars. Ward steam couplers in three sizes were shown. End train pipe valves and automatic steam traps were exhibited together with pressure regulating valves, starting valves, steam gauges and all the fittings and attachments necessary to a complete installation. Ward's car ventilator was also shown and the very ingenious Ward's automatic connector for air brake signal and steam pipes.

Watson Stillman Co., of New York, displayed their portable shaft straightener, their hydraulic jacks, rail benders, independent pump jacks, their hydraulic crank pin presses and hydraulic wheel presses. A glance at the number and variety of jacks made by this company gives a good idea of the state of the art up to date.

Whiting Foundry Equipment Co., of Harvey, Ill., exhibited models of their mechanical and electrical brake for hoisting machinery as applied to cranes.

Wilmarth & Morman Co., of Grand Rapids, Mich., exhibited their Yankey drill grinders; of these one was motor driven, one was a wet grinder, one was a dry grinder, one a combination cutter, reamer and drill grinder, one new surface grinder, and one Nelson loose pulley.

Regular Rail Record.

The Pennsylvania Railroad has recently placed a large order for steel rails amounting to about 55,000 tons, which are to be rolled according to the new specifications of the company. The manufacturer may use either the Bessemer or the open-hearth process, the desired composition being 0.50 per cent carbon, 1.00 manganese and 0.12 silicon for Bessemer rails and 0.75 carbon and 0.12 silicon for open-hearth rails. These quantities are, of course, fractions of one per cent.

It is the intention of the railroad to maintain a very close record of the durability and reliability of these rails so that future practice may be based on the accurate statistics and data. In addition to the usual markings on the rails, a letter is to be stamped on each rail in order to indicate the part of the ingot from which that particular rail was made.

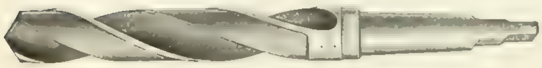
Rail failures will be carefully recorded and periodical measurements of rails will be made in order to determine the amount of wear of different sections and different compositions, notice being taken of the locality and the amount of traffic carried.

In order to compile and consider the results of the company's experience with rails a special committee has been appointed whose duty it will be to supply the officials with data that will enable them to obtain rails which, at the time any order is placed, will be the best that it is possible to manufacture.

Bulletin No. 15 of the Engineering Experiment Station of the University of Illinois on "How to Burn Illinois Coal Without Smoke," by Prof. L. P. Breckenridge, was published in December, 1907, but on account of the large number of requests for it, a second edition of 10,000 copies has just been issued. A few pages are devoted to the principles of combustion and the losses due to smoking chimneys, but the larger part of the bulletin relates to the constructive features of those boiler settings and furnaces that have been found practically smokeless in operation at the power plant and in the experiment station at the University of Illinois. The leading dimensions of the settings and furnaces are given and sectioned cuts show the general character of the settings. While the smokeless burning of Illinois coals furnishes the main discussion, the principles and methods explained apply equally well to the burning of all kinds of soft coal. A large number of the copies already distributed have been requested by the smoke inspection departments of many of our large American cities. Copies of this bulletin may be obtained gratis upon application to the Director, Engineering Experiment Station, Urbana, Illinois.

Tang, Tind, Teen.

Anyone knows what the tang of a knife blade is. It is the part which is inserted into the handle to hold the knife, and many people think the word "tang" is a corruption of "tongue," but it is not. A tang is really a sharp point and comes from the old Anglo-Saxon word tind, which means a prong, and this is allied to teen, the word used in describing the various prongs on the antlers of a deer. The



TWIST DRILL WITH DOUBLE TANG.

prongs of a fork are teens. The tang of a knife or a sword is the part which fits into the handle and the tang of an ordinary twist drill is the part of the shank which when fitted into the socket does the driving.

In nearly every railroad shop there are always a lot of old drills, quite good as far as that goes, but with the tangs twisted off. To make these drills serviceable again the shank has to be turned down to fit the socket and a new tang put on. This is not an easy thing to do accurately, and there is a good deal of work involved in the process. The Cleveland Twist Drill Company have taken hold of this very thing and have got out what they call the Perfect Double Tang Sockets for drills. When one of their latest drills is new it has two tangs, one above the other on the shank, making a kind of step, and when slipped into the double tang socket the two stepped faces of the tangs drive the drill. The lower and thicker tang is of course the stronger of the two, but both do their work at the same time.

Now comes the advantage of the double tang idea when dealing with the otherwise serviceable drills on the scrap heap. You do not have to turn down the whole shank to fit the taper socket; it fits now, but the tang is gone. All that is necessary is to grind on a new and thicker tang, lower down the shank, and let it go at that. You then have a drill with one tang, as you had before, but the tang is stronger because it is thicker and will probably last as long as the drill. The perfect double tang drill socket takes new drills with the double tang, or it will take drills with the one small original tang (though you can easily put the second one on), or the socket will take the drill with the original tang twisted off, if you grind on the second and stronger one. The double tang socket will take whatever you have, and the idea seems to have a lot of economy mixed up with it somewhere. The Cleveland Twist Drill Co., of Cleveland, Ohio, have a very interesting little circular on this subject. We have mentioned some facts about the origin of the word tang. Drop a post card to the Cleveland Co. and they will tell you about their double tang idea and the economy contained therein.

Strength of Chain Lengths.

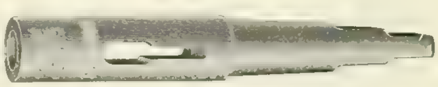
A series of experiments on chain links and circular rings, covering a period of two years, has been made for the purpose of confirming or disproving a theoretical analysis of the stresses in links and rings. A comparison of calculated and measured distortions affords the desired test. The result of the experiments is a complete confirmation of the analysis. It is shown that the usual formulas for chain loads give maximum tensile stresses of 33,000 to 40,000 lbs. per sq. in. and maximum compressive stresses of 60,000 lbs. per sq. in. New formulas for safe loads are proposed. This bulletin, No. 18, on the strength of chain links, will be of interest to engineers and manufacturers who are concerned in any way with hoisting and transmission. Copies may be obtained upon application to the director, Engineering Experiment Station, University of Illinois, Urbana, Ill.

New Railway in Palestine.

A railway is in course of construction from Jerusalem northward joining the branch already opened from Mount Carmel to the Sea of Galilee. The route will pass many points of historic interest, including Bethel, Shiloh, Jacob's Well, Mount Gilboa and Jezreel. Pilgrims to Jerusalem will soon be carried in first-class accommodation cars from Joppa to Jerusalem, thereby avoiding the tedious mule and pony relays which are not only expensive, but painful experiences. Doubtless the new railway will have the effect of attracting thousands of extra visitors to Palestine.

To Close the Dampers.

A curious little machine has been invented whereby, when the heat of a candle is applied to it from the fraction of a minute, a man weighing 150 lbs. can be raised several inches. This wonderful piece of



DOUBLE TANG HOLDER.

mechanism is known as the regitherm, and its purpose is to control the temperature in houses by closing and opening the draughts in stoves and furnaces. Hermetically sealed within the regitherm is a small amount of volatile liquid, the vapor of which changes its pressure at the rate of one-half pound per square inch for each degree of change in temperature. A change of a single degree in the temperature develops a force of 15 lbs. within the motor. This force acts to expand the vessel through a distance of half an inch,

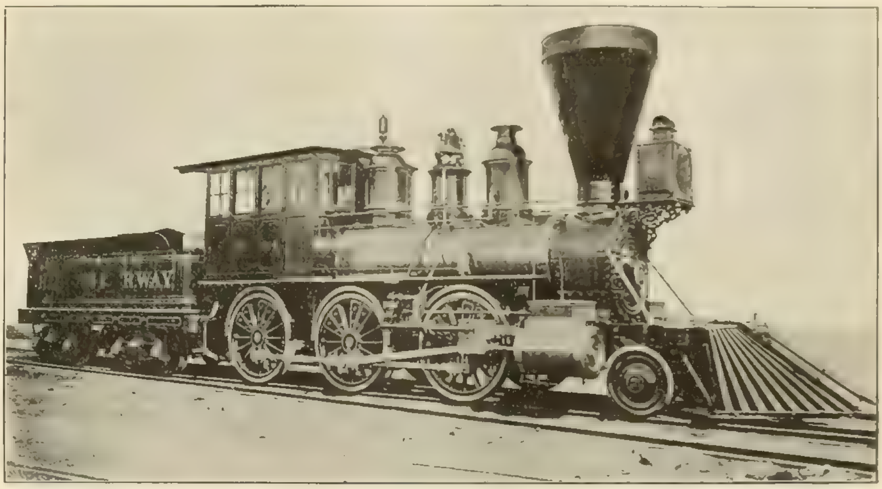
and this movement is magnified eightfold in being transmitted to the dampers, thus imparting to the latter a movement of four inches.

Lacquers and Paints.

One sometimes hears persons who do not even know what ordinary paint really is speak enthusiastically of the rich lustrous colors of French or Japanese lacquers. As a matter of fact lacquer has no color of its own, and is generally composed of a clear resinous gum dissolved in turpentine and oil. It is usually applied to a surface which already has a color of its own, and the addition of the lacquer adds a hard, transparent, glossy finish which gives brilliance to the color underneath in very much the same way that a plate of glass placed over a portrait will enhance the color effect of an oil painting. Lacquer without any color value itself spreads as an homogeneous film on the surface to which it is applied.

Paint differs from lacquer in the fact that it possesses color. It is made by the grinding up of some pigment into a very finely divided or powdery state and mixing it with oil and turpentine. When spread upon a smooth surface the film imparts its own color to the surface. Paint is a mechanical mixture in which minute particles of the pigment are completely surrounded by oil. As the film dries, as we call it, the turpentine evaporates and the oil solidifies so that a fine close mass of coloring particles and dry oil, if one may so say, lies on the surface. Viewed through a powerful microscope paint is analogous in its structure to thin ice impregnated with sand. The ice remains ice and the sand is still sand, though closely and intimately mixed with each other. The oil solidifies and holds the pigment as ice holds sand.

Lacquer, as we have said, is a solution of gum, while paint is a mechanical mixture pure and simple. A very successful attempt to unite the features of lacquers and paints has been achieved in the production of a protective coating called "Eldo." The body of this coating is a carbonaceous or carbonized gum which is capable of being held in solution in various vehicles and yet retaining its color quality. Being in essence carbon it has the property of resisting the action acids or alkalis, and its heat resisting qualities are very marked. This protective coating, like lacquer, is homogeneous, and like true paint it possesses covering qualities, and has distinctive color of its own. The makers say of it: "The fact that it is a clear solution gives it covering qualities of far greater extent than any paint, and if properly applied it will coat from two to four times the surface that can be covered by any pigment paint, and also owing to the nature of its composition, it exceeds the covering qualities of the majority of lacquers."



OLD DANFORTH COOK & CO.'S ENGINE ON THE ERIE.

It is of course a patented article and has been the result of a series of very carefully conducted research experiments by expert chemists. It is applicable to a variety of uses in railroad work and on the front ends of locomotives it has been found most satisfactory as the heat of the smoke-box, instead of rapidly drying and cracking it, tends to bake it into a solid tenaceous though thin coating. The Eldo Company of 100 William street, New York, are manufacturing this protective coating, and will be pleased to answer any questions whether general or technical, concerning their product. "Eldo" has only recently been put on the market and is worth inquiring about, especially as a smoke box coating.

A man is already of consequence in the world when it is known that he can be implicitly relied upon.—*Lytton.*

An elegant, thirty-page pamphlet, illuminated with tinted illustrations has been issued by the Garlock Packing Company, Chicago, Ill. The high pressure packing manufactured by this company has been a prime favorite among railroad men for many years. The use of superheated steam has called for the highest quality of materials and workmanship in ring, spiral and coil packing. A diagonal ring style is illustrated which shows some new features and is especially adapted for scored rods or flat-bottom boxes. The various styles of hydraulic packing are also shown adapted to any pressure up to 2,500 lbs. The sheet form of packing is also fully shown, and all who have had an opportunity of testing the qualities of the wire insertion asbestos packing are loud in its praises. A copy of this fine pamphlet should be in the hands of all who are interested in high pressure packing. Send for a copy of catalogue "L," to the company's offices, 115 S. Franklin Street, Chicago, Ill.

The Pyle National Electric Headlight Company, Monadnock Building, Chicago, have just issued a finely illustrated pamphlet with descriptive letter press, showing the merits of the "Ross Special" case and reflector as applied to their electric headlights. The chief features of the new device are a front goggle and inner ring which allows perfect ventilation, which prevents the breaking of headlight glasses. The goggle and attachments are so hinged, as to give free access to the reflector for cleaning. The apparatus is readily removable if necessary, and the old-fashioned oil headlight can be used if emergency requires.

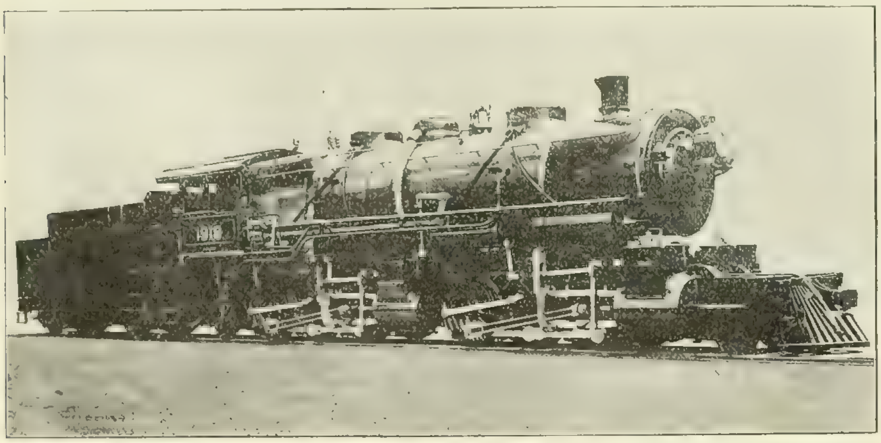
They Do It Thus in England.

Concerning what in this country we call Employers' Liability, but which our English friends call Workmen's Compensation, the Pall Mall Gazette says:

"The case of Emma Dewhurst, charwoman, contains a solemn warning to householders who may have neglected to insure. She was working two days and one afternoon per fortnight, and her weekly pay, exclusive of meals, came to 2s. 7½d. per week. A prick from a pin in the floor cloth was followed by blood poisoning, and the woman has permanently lost the use of her left hand. At Preston County Court the judge held that as she worked at fixed times she was a regular and not a casual employee, and therefore he awarded her 7s. per week under the Workmen's Compensation Act. For this sum the employer, who paid only 2s. 7½d. per week for her work, will be responsible during all the years of her enforced idleness."

Jenkins Brothers, 71 John Street, New York, have issued a neat pamphlet showing their specialties in globe valves. An admirable opening essay on valve troubles will be warmly appreciated by all who have handled valves. The common troubles are pointed out and the methods of evading them are led up to in a way that is as interesting as it is valuable. A variety of valves are passed in review and all are fully described and finely illustrated. It may be noted as a leading peculiarity of the Jenkins valves that it is not necessary to shut off steam to pack stuffing-boxes, as by opening them wide they can be packed under full head of steam.

Asbestos roofing is coming into popular favor since the H. W. Johns-Manville Co., of New York, perfected several improvements in the adaptation of asbestos as a covering for roofs and walls. In the perfected form as supplied by the company, anyone can put it on. Nails and cement are furnished with each roll. A hammer and a sharp knife is all that is necessary. Samples and prices will be furnished on application to the Company's offices, 100 William street, New York.



GREAT NORTHERN MALLET COMPOUND WITH BALDWIN REVERSING GEAR.

The Dressel Railway Lamp Works, of New York City, have just perfected a new burner which they have called the "Dressel No. 0." They have realized for some time that there is a demand for a burner which may be used in places where it is found to be desirable to have a somewhat greater flame than that supplied by the "Long Time" or, as it is commonly called, "Seven Day Burner." To meet this demand, the No. 0 burner, using a cotton wick, has been devised. This burner may be applied to any fount using the long time burner, as it is so constructed as to be interchangeable, the flame being in exact focus when in the fount. The oil consumption, on account of the perfect combustion, is very small, being only about ½ ounce per hour, so that it may be depended on for about 50 hours, with the ordinary 25 oz. oil pot. Samples of these burners will be sent for trial to any signal engineer or maintenance of way official who will request the Lamp Works for one.

Experiments continue to be made in regard to the loss of the calorific value of coal during storage. Coal under various conditions of storage shows a loss from two to ten per cent., except when entirely submerged in water. It is noted that the loss almost ceases after five or six months. Next to complete submersion in water, the repeated drenching by water has some saving effect on the value of coal exposed to ordinary dry temperatures.

Running Time Is Fast.

What we show in our illustration is not exactly a mechanical appliance used on railroads, but is a reproduction of an excellent photograph sent us by our old friend, Mr. F. W. Blauvelt, of New York. This is not the first time the work of his camera has appeared in the pages of RAILWAY AND LOCOMOTIVE ENGINEERING, as many of our readers know. This time he has sent us a high speed bird, if we may so say. While at Hot Springs, Ark., he and a friend and the bird "got together." In his letter enclosing the photograph he says:

"While at Hot Springs a friend of mine, Mr. L. G. Everist, of Sioux City, Ia., and myself wanted to take a ride, and not being able to get an automobile we finally procured a 'horseless carriage' of one ostrich-power, and to say the least 'it was a bird.' This particular ostrich is somewhat noted; he is 28 years old, is broken to harness, and is said to be worth $10,000. He is known as 'Black Diamond,' and it might be said that we were riding on the 'Black Diamond Express,' for his Ostrichship has a 'track' record, to the wagon shown, of one minute and five seconds for a half mile."

A "BLACK DIAMOND" OF THE WEST.

That is a speed of very nearly 30 miles an hour pulling the vehicle. An ostrich, when going it alone, is said to be able to cover the ground at a speed of 94 ft. a second, and it is also said that he uses his wings, though, of course, he cannot fly. That pace is equal to more than a mile a minute, and is a creditable performance no matter how it is done.

INDEX TO ADVERTISEMENTS

Railway and Locomotive Engineering

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A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXI. 114 Liberty Street, New York, August, 1908 No. 8

The California Limited.

The California Limited on the Atchison Topeka & Santa Fe Railway is a splendid passenger train which runs every day, the year round. It starts from Chicago at 8 P. M. and arrives in San Francsico at 7:45 A. M. on the fourth day thereafter. It begins the journey say on Monday on just 59 hours 59 minutes on the road. The mileage between Chicago and San Francisco is 2,576 and the schedule gives No. 3 an average speed of 41.73 miles an hour, and No. 4 travels at about 42.9 miles an hour.

The equipment of the train is of the finest. The train is made up of a ten-section double drawing-room Pullman sleeper, a ten-section single drawing-room, and two staterooms Pullman sleeper, a standard compartment sleeper, a dining car, a buffet smoking car, reading, and smoking room, and barber shop, and an observation car with library and a commodious parlor. The entire train is wide vestibuled, and well ventilated. It is electric lighted throughout, each section having two separate lights conveniently placed. Electric fans are also provided. Current periodicals and newspapers and stationery are furnished in both the buffet smoking car and observation car, also the market reports by wire. No extra fare is charged beyond the cost of regular first-class one-way or round-trip tickets. The train runs daily between Chicago, Kansas City, Los Angeles, San Diego, and San Francisco, on rock-ballasted and oil-sprinkled tracks, safeguarded by block signals. The scenery through Colorado, New Mexico, and Arizona is unique in all the world. At times the traveler is more than a mile above the sea, where the

THE CALIFORNIA LIMITED ON THE ATCHISON, TOPEKA & SANTA FE.

Central standard time, and at Dodge City in Kansas the time changes to mountain time. One hour is added to the time table for No. 3, the west bound train, and again at Seligman in Arizona, near the Grand Canyon, another hour is added, as the time here changes to Pacific standard. In this way the train is on the road 61¾ hours and No. 4, the east bound train, is

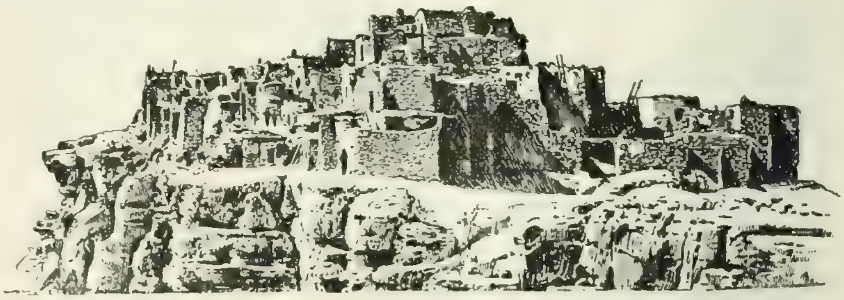
air is always dry, pure, and bracing. The California Limited runs through the southwest land of enchantment over the historic Santa Fe trail.

The traveler in this region can visit the old missions, which were planted in the early days of struggle and danger. He can wander among forests of mammoth trees, such as are found nowhere else on earth. He can explore the incomparable Yosemite Valley, nature's wonderland, and he can scale the snow-crowned Sierras or enjoy the cool breezes from the Pacific.

Among the many wonders of this western land of the new world one may see the works of primative man and of nature. old before the dawn of civilization as we know it, had begun. In New Mexico are the famous Pueblo Indians, so called from their town-building characteristic, as they were more advanced than the savage tribes which peopled the eastern portions of North America. The Pueblo Indians had abandoned the nomadic or wandering habits and lived in what may be called a communal habitation, a town so to speak, in one structure. It was primitive, flat life, if one may borrow a present day term and apply it to past times. Pueblos were built of stone, but oftener of adobe or sun-dried brick. They were several stories high, each story being built back from the front of the one

THE GRAND CANYON, COLORADO.
(Copyright Kolb Brothers, 1908.)

below, so as to afford those on each of the upper stories a sort of terrace in front of their dwellings. The general plan adopted was that of a hollow square, though sometimes the ground plan had a curved outline. Many of these pueblos were built on commanding eminences, so as to permit the inhabitants to obtain a view of the surrounding territory and thus render the stealthy approach of an enemy impossible. They were often arranged so as to surround three sides of a court and the ground floor had no doors or windows. Ladders were



MOKI PUEBLO OF WOLPI ON THE SANTA FÉ ROUTE.

used to enter the pueblo, which was done over the roofs of the lower tier of dwellings and these ladders were then drawn up and entrance to the lower dwellings was effected through trap doors.

The idea in the location and design of the pueblo was that of community life, with the most effective means of defense. One such building frequently housed a whole tribe. The form of government adopted by these Indians was peculiar to them, each village or pueblo electing a governor and council. They cultivated the soil adjacent to the village and also subsisted on the proceeds of the chase.

Pueblo architecture possesses nothing of the elaborate ornamentation of the Astec dwellings in Mexico. The most striking pueblo along the Santa Fe route is that of Acoma. "Anciently, according to a native tradition, for which Mr. C. F. Lummis is authority," so says Mr. C. A. Higgins, writing for the Santa Fe, "the original pueblo of Acoma stood upon the crest of the Enchanted Mesa, 430 ft. above the valley. Its only approach was one day destroyed by the falling of a cliff, and three sick women, who chanced to be the only occupants, the remainder of the population being at work in the fields below, perished there, beyond reach of aid from their people, who then built a new pueblo on the present site. In 1897 an eastern college professor laid siege to the Mesa Encantada with a mortar and several miles of assorted ropes, supplemented by pulleys, a boatswain's chair, and a team of horses. By these aids the summit was reached, but the party reported that nothing was found to indicate that it had ever been visited before by man."

Another of the wonders of this western land is what are called the petrified forests of Arizona. As one stands amid the fallen and now stone giants of the primeval forest one is in the presence of such hoary antiquity as makes the time covered by the pages of recorded history dwindle into utter insignificance. Thousands of acres are here strewn with trunks and segments of what once was a living leaf bearing vegetation. Some of these prostrate trees of stone are over 200 ft. in length and 7 to 10 ft. in diameter, now broken into sections by transverse fracture. One of these huge trunks, its integrity still spared by time, spans a canyon 50 ft. wide, a bridge of jasper and agate overhanging a tree-fringed pool.

Mr. John Muir, the well known California naturalist, says of the North Sigillaria Forest that the many finely preserved *Sigillaria, Lepidodendron* and *Dadoxylon* trees, with their peculiar roots and leaf-marks, show plainly that in this place flourished one of the noblest forests of the Carboniferous period. The trees grew where they now lie, instead of drifting in from elsewhere, and there are many standing stumps visible. The forest covers many thousands of acres, in five separate tracts."

These trees of the carboniferous period were not flowering plants, and in a general sense they may be described more as gigantic weeds and grasses than trees

as we know them. Sigillaria was a sort of tree fern and had a curious arrangement of roots which radiated from the central mass of the trunk something like an enormous cart wheel divested of its rim. The Lepidodendrons were great plants of the club-moss type which rose upwards of seventy feet in height. The Dadoxylons were allied to the conifers or pine trees. The growth was luxurious and greedily drank up moisture from the damp soil in which it stood. There was no blow of bright color and no luscious fruit; it was hard, dry and flowerless.

AGATIZED TREE SPANNING RAVINE. ALONG THE SANTA FÉ.

Hugh Miller, in his notable work, "The Testimony of the Rocks," when speaking of the plants which in the lapse of ages were transformed into coal, says, "In no other age did the world witness such a flora; the youth of the earth was a peculiarly green and umbrageous youth, a youth of dusk and tangled forests of high pines and stately araucarians, of the reed-like calamite, the tall tree fern, the sculptured sigillaria and the hirsute lepidodendron. Wherever dry land or shallow lake or running stream appeared, a rank and luxuriant herbage cumbered every footbreadth of the dank and steaming soil; and even to distant planets our earth must have shown through the enveloping cloud with a green and delicate ray."

The petrified forests of Arizona, however, did not turn to coal. Owing to chemical action they became masses of agate, jasper and chalcedony. They originally grew beside what was millions of years ago an inland sea and the process by which they have become turned into blocks of stone, capable of being cut, polished and wrought into gems casts a sidelight on the complete but slow-moving processes of nature and the prodigious lapse of time required to effect the wonderful change.

In his work on "Gems and Precious Stones of North America," Dr. G. F. Kunz thus describes the theory of petrifaction. He says, "Wood buried in soil soaked with some petrifying material becomes highly charged with the same and the cells filled with the infiltrating matter, so that when the wood decays, the petrifying material is left, retaining the structure of the wood. Furthermore, as each particle of organic matter passes away by decay a particle of mineral matter takes its place, until finally all the organic matter is replaced. The process of petrification is therefore one of substitution as well as of interstitial filling. From the different nature of the process in the two cases, it happens that the interstitial filling always differs, either in chemical composition or in color from the substituting material. Thus the structure remains visible, although the mass is solid.

It is perhaps allowable to liken this process to the filling of a sponge with mucilage. The gummy substance enters all the minute pores of the sponge and thoroughly impregnates the whole. In time the mucilage hardens and the sponge becomes a solid mass. Later, suppose the very fiber of the sponge decays and as each particle disappears, it is replaced by a particle of heavy dark glue, so that when the spongy material has entirely passed away, there remains the form of the sponge faithfully preserved. The structure being easily discernable, for what once were the minute spaces and pores, are now occupied by solid mucilage and the material of the sponge itself has been replaced by hard, dark colored glue. In some such way these stone trees were made.

Speaking of one of the most wonderful of these regions, Dr. Kunz says: "In the silicified forest, known as Chalcedony Park, situated about 8 miles south of Corrizo, a station of the Atlantic & Pacific Railroad, in Apache County, Arizona, the country formation is sandstone or volcanic ash and the trees are exposed in gulches and basins where the water has worn the sandstone away.

"The jasper and agate generally replaced the cell walls and fibers and the transparent quartz filled the cells and interstices, especially where the structure was removed by decay. * * * There is every evidence to show that the trees grew beside some inland sea. After falling they became water-logged, and during decomposition, the cell structure of the wood was entirely replaced by silica from sandstone in the walls surrounding this great inland sea.

"It is by the washing and weathering away of this formation (sandstone) that the tree trunks have rolled down to the level plane below. None of those lying below were ever in place there. None that are in the upper layer are in the upright position, nor were any roots visible, and since none of the trees retain any of the original bark, it seems very probable that all this deposit was once the bed of an inland sea or lake.

One must not forget in this wonderland of old the modern locomotive by whose aid the traveler is carried over plain and mountain and through forest and ravine. The dimensions were given by Mr. W. F. Buck, superintendent of motive power. The magnificent 4-4-2 engines are balanced compounds, weighing 201,500 lbs. Of this amount the engine and trailing trucks carry 102,300 lbs., leaving 99,200 lbs. on the drivers. The engines are equipped with traction increasers which, when in use, alter the weight on the drivers to 109,700 lbs. and reduce the total

on the trucks to 91,800 lbs. The cylinders are 15 and 25 x 26 ins., with 79 ins. in driving wheels. These engines were built by the Baldwin Locomotive Works and do excellent work on the famous daily trains of the California Limited of the Santa Fe, through the country where "every month is June."

Car Ferry "Ontario."

Our illustrations show the new Grand Trunk Railway car ferry "Ontario No. 1." This magnificent steamship, for such it is, plies between Cobourg, Ont., and Charlotte, the port of Rochester, N. Y.

The length of the boat is 315 ft, beam 54 ft., depth of hold 20 ft., height between decks 17 ft., making her the largest car ferry of Canadian register. Twenty-eight loaded coal cars can be carried at once, while the vessel has been built so as to enable her to run all the year round. Her speed is 15 knots. There is stateroom accommodation for about one hundred passengers on the upper deck. The total cost was about $375,000.

The object of this car ferry service is to shorten the distance between the central portion of the Ontario and the Eastern States. The all-rail route makes it necessary to haul freight and passengers by way of Montreal or Buffalo and thus a great deal of parallel mileage would have to be made on either side of the lake. The car ferry across the lake, where it is about 40 miles, greatly reduces time and total mileage made by the cars.

There is a great deal of traffic now originating in Pennsylvania, such as coal and iron, which goes to Canada via the lake route and a great deal of traffic in timber and ore from Canada comes to the United States. It is said that cars of fast freight from Pittsburgh to Montreal can be delivered seven or eight days earlier by taking the lake route rather than going all the way round by rail.

The Grand Trunk ferry is built for rough weather and for cutting through lake ice. It has a sharp, straight bow and in this it resembles a regular passenger steamer. The cars are entirely under cover when on the ship and they are run on and off at the stern. This vessel was built at the Polson Iron Works, Ltd., Toronto. The ferries make seven round trips a day, but in busy seasons they will be run day and night.

GRAND TRUNK CAR FERRY ONTARIO NO. 1.

Railroad Jumbles.

At a recent meeting of the Richmond Railroad Club, Mr. Wm. M. Bickers, chief train dispatcher of the C. & O. Ry., Richmond, Va., read an original paper on the subject of "Railroad Jumbles." It was a happy departure from the matter and style of papers usually delivered before railroad clubs. Mr. Bickers had a delightful collection of humorous railroad stories, many of which were the account of personal experiences on railroads. Like one of the characters so happily described by Charles Dickens, Mr. Bickers occasionally "dropped into poetry." His mastery of the Southern negro dialect is particularly fine, and we hope that members of other railroad clubs will imitate Mr. Bickers' excellent example in mixing dull matters of fact with subtle flashes of fine fancy.

UPPER DECK G. T. R. CAR FERRY.

It is a sign of a nature not finely tempered to give yourself up to things which relate to the body; to make a great fuss about exercise, about eating, about drinking, about walking, about riding. All these things ought to be done by the way; the formation of the spirit and character must be our real concern. *Epictetus.*

Undertake not what you cannot perform, but be careful to keep your promise. *George Washington.*

American Ties in Honduras.

A railroad in Honduras, which has just been opened to traffic as far as Ceiba, 35 miles, was built with creosoted pine ties from the United States. This indicates that some foreign railroad companies are more solicitous about preserving ties than railroad companies in North America.

The increased value of wood thus preserved is now well recognized by railroad men. The life of a railroad tie may be greatly lengthened and sometimes more than doubled by preservative treatment. In a humid climate like that of Honduras a pine tie in its natural state would be quickly destroyed by fungus.

Large railroads of the United States treat with preservatives many, or all, of the new ties put in. One road is said to treat 10,000 a day. The increasing difficulty of procuring new ties, with the advancing prices, compels railroads to make them last as long as possible. It has been estimated that the railroads of the United States demand in a single year the ties growing on a forest strip one mile wide and three thousand miles long.

It is worthy of note that while creosoted pine ties are being shipped from the United States to Honduras, hardwoods are coming to the United States from that country. Americans are doing the shipping both ways. A tract of 8,000 acres in Honduras has been secured by an American company, which will cut the mahogany and other valuable hardwoods and ship them to the United States.

Highest in the World.

One of the most interesting railway trips in the world is that over the Oroyo Railway, which runs from Callao to the goldfields of Cerro de Paeco. It is considered one of the wonders in the Peruvian world. It is certainly the greatest feat of railway engineering in either hemisphere. Commencing in Callao, it ascends the narrow valley of the Rimac, rising nearly 5,000 feet in the first forty-six miles. Thence it goes through the intricate gorges of the Sierras till it tunnels the Andes at an altitude of 15,645 feet, the highest point in the world where a piston-rod is moved by steam. This astonishing elevation is reached in seventy-eight miles.

SHARP BOW OF G. T. R. CAR FERRY.

Oil Burning Ten-Wheeler.

Last month we gave some interesting particulars of the firebox arrangement and burners used on the Southern Pacific engines which use crude oil as fuel. The details of the method were worked out by Mr. T. W. Heintzelman, superintendent of motive power of the road. This month we are able to present to our readers a fine example of the oil burning passenger engines used on that road.

The Brooks Works of the American Locomotive Company have recently completed an order of 24 ten-wheel locomotives for what are sometimes called the Harriman Lines. The engines are part of a total order for 125 locomotives placed with the American Locomotive Company for that system. The order included 43 consolidations, 30 moguls, 10 Atlantics, 18 switchers and 24 ten-wheelers. Of the ten-wheel engines eighteen were equipped for burning oil and six consigned to the Oregon Railroad and Navigation Company were arranged for burning coal. Five of the eighteen oil burning engines went to the Central Pacific, 6 to the Galveston, Harrisburg & San Antonio Railway, 2 to the Oregon & California Railway, and 5 to the Southern Pacific Company, one of which is shown in our half-tone illustration.

These engines are for passenger service and were built to drawings and specifications furnished by the Railroad Company and represent the design which has been adopted as standard for this type of engine for all associated lines. In working order they have a total weight of 207,000 lbs., which places them among the heaviest engines of this type ever turned out by the builders. Of this total weight 162,000 lbs., or 78.6 per cent. is on the driving wheels. The cylinders are 22 ins. in diameter by 28 ins. stroke, and with a boiler pressure of 190 lbs., and driving wheels 61 ins. in diameter, these engines will develop a maximum tractive effort of 34,740 lbs. This gives a factor of adhesion of 4.68.

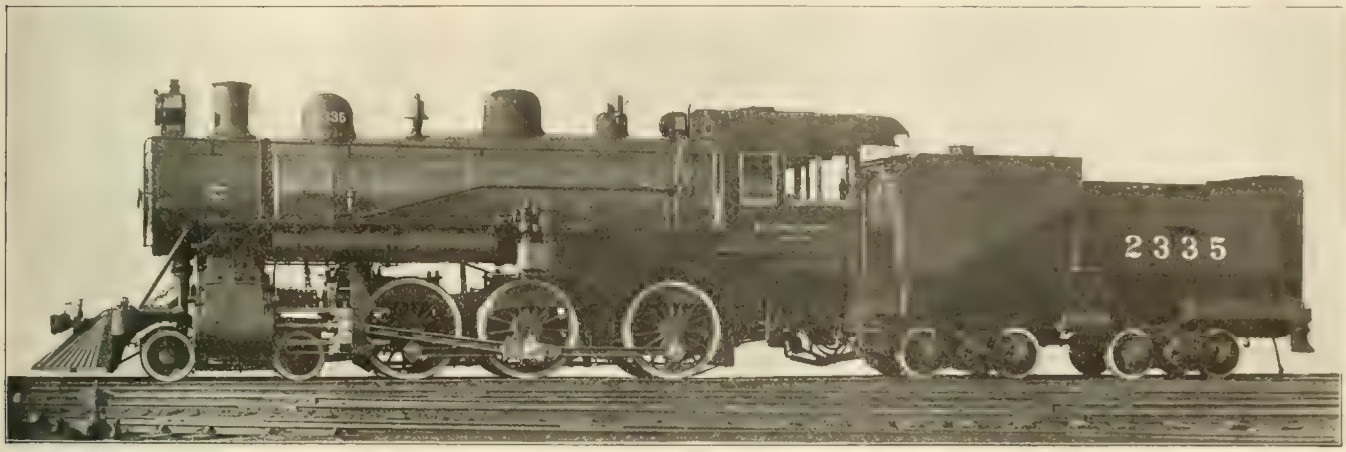
The cylinders are equipped with piston valves having a maximum travel of 6 ins. and one inch steam lap and 1/16 in. exhaust clearance. The valves are actuated by the Stephenson shifting link motion and are set for 1/32 in. lead in full gear. The main frames are of cast steel with double front rails and are $4\frac{1}{2}$ ins. wide. The wheels are all flanged, and main and side rods are of the I-section type. The butt-end of the connecting rod being furnished with strap with wedge adjustment for the brasses. The side rod brasses are solid.

The boiler is of the wagon top crown bar type with vertical backhead and throat sheet. The barrel is built up of three courses, the outside diameter of the first course being 72 ins. It contains 355 tubes 2 ins. in diameter, so spaced as to provide ⅞ in. bridges in accordance with the standard practice of the Harriman Lines. The total heating surface of the boiler is 2,994 sq. ft., of which the tubes contribute 2,788 sq. ft. and the fire box the remainder. The fire box is 124 ins. long, $37\frac{1}{4}$ ins. wide. The crown sheet is supported by T-iron crown bars attached by sling stays to curved T-irons riveted to the roof sheet. The crown and sides of the fire box are in one sheet as are also the sides and roof of the boiler. Ample water spaces are provided around the fire box, the mud ring being 5 ins. wide on all sides and the water spaces increasing in width at the crown sheet. The seams of the barrel courses are on top of the boiler and the welts are of diamond shape.

The tender is of the Vanderbilt type with cylindrical tank having a water capacity of 7,000 gallons. The oil for fuel is carried in a tank placed in the coal space of the tender and having a capacity of 2,940 gallons. The tender trucks are of the Andrews cast steel side frame type; the wheels being of rolled steel $33\frac{1}{2}$ ins. in diameter. A tool box is conveniently located below the running board on the tender at the back.

The principal ratios and dimentions of the design are given below.

Weight on drivers ÷ tractive effort . . . . [illegible]
Total weight ÷ tractive effort . . . . [illegible]
Tractive effort × diam. drivers ÷ heating surface . . . . [illegible]
Total heating surface ÷ grate area . . . . [illegible]
Fire box heating surface ÷ total heating surface (per cent.) . . . . [illegible]
Weight on drivers ÷ total heating surface . . . . [illegible]
Total weight ÷ total heating surface . . . . [illegible]
Volume both cylinders, cu. ft. . . . . [illegible]
Total heating surface ÷ vol. cylinders . . . . [illegible]
Grate area ÷ vol. cylinders . . . . [illegible]
Wheel Base—Driving, [illegible] ft. [illegible] ins.; total, [illegible] ft. 10 ins.; total, engine and tender, [illegible] ft. [illegible] ins.
Weight—In working order, engine and tender, 3[illegible],000.
Grate area, 32.1.
Axles—Driving journals, main, 10 ins. x 12 ins.; others, 9 ins. x 12 ins.; engine truck journals, diameter, 6 ins., length, [illegible] ins.; tender truck journals, diameter, $5\frac{1}{2}$ ins.; length, 10 ins.
Fire Box—Type, top of frames, length, 124 ins.; width, $37\frac{1}{4}$ ins.; thickness of crown, ⅜ in.; tube, ½ in.; sides, [illegible] in.; back, [illegible] in.; water spaces, 5 ins.
Tubes—Length, 15 ft.; No. 12 gauge.



OIL BURNING FREIGHT 4-6-0 FOR THE SOUTHERN PACIFIC.

H. J. Small, Genl. Supt. of Motive Power. American Locomotive Company, Builders.

Boxes—Driving, main, cast steel; others, cast steel; brake pump, New York No. 5; reservoir, 20 ins. x 193 ins.
Engine truck—4-wheel swing centre.
Piston—Rod diameter, 4 ins.
Smoke Stack—Diameter, 20 ins.; top above rail, 15 ft. $2\frac{1}{2}$ ins.
Valves—Setting, 1-32 in. lead in full gear.
Wheels—Driving material, cast steel; engine truck, diameter, $30\frac{1}{2}$ ins.; kind, rolled steel; tender, $33\frac{1}{2}$ ins.

The report of an interesting test between a four-cylindered Mallet type compound engine and two smaller designs of freight engines equalling together the Mallet engine, on the Northern Railway of France has just been published. Two standard trains weighing 950 tons each were hauled over the same course for nearly six months. The distance run by both trains was 20,000 km. or 12,427 miles. The fuel consumed by the Mallet engine cost $457.00, as against $582.00 by the smaller engines. In the matter of lubricants the Mallet cost $24.40 as against $19.60 for the two others. The total expenses including wages and repairs were $762.00 for the Mallet type and $1,041.00 for the two older types of engines. The competition resulting in a monetary victory for the Mallet engine which amounted to $279.00.

Pennsylvania Steel Coach.

The Pressed Steel Car Company of Pittsburgh recently built a number of passenger cars which are being delivered to the Pennsylvania Railroad on an order of 85 cars. The design was prepared by the Pennsylvania Railroad. The car is noncombustible, no inflammable material being used except for the window sash and seat arm rests, which are of mahogany and which in weight represent about two-tenths of one per cent. of the entire car. These cars have the distinction of having less wood in their construction than any coaches ever built in this country for use on a steam railroad, the small percentage of non-fireproof material is not a part of the structure, but merely a part of the trimming.

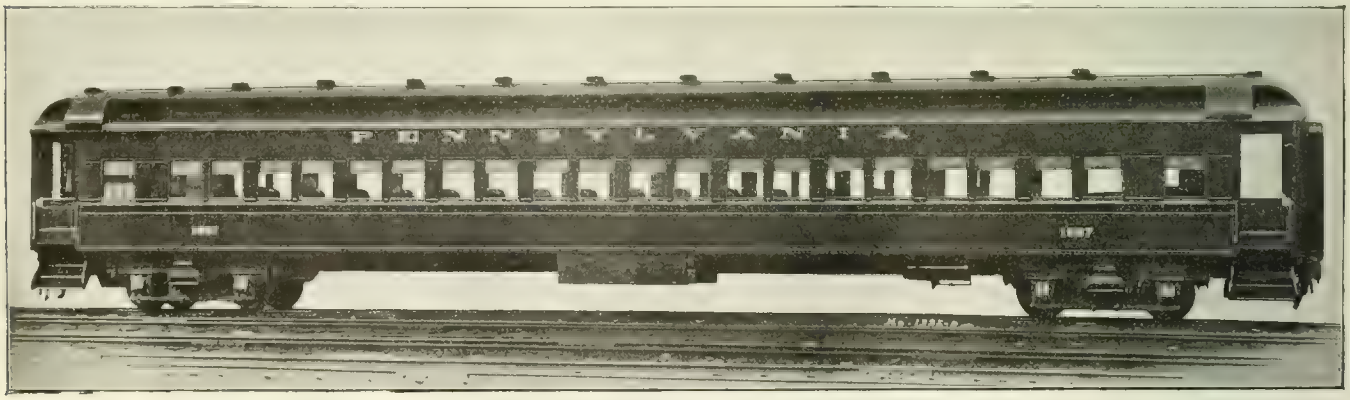
The car has a seating capacity for 88 passengers and weighs complete 113,800 lbs., which includes storage batteries weighing 5,800 lbs. It is interesting to note that the dead weight per passenger is about 1,290 lbs., which compares favorably with a modern wooden coach if such cars are equipped with the same specialties and storage batteries as are used on this car. The weight of wooden cars average about 1,450 lbs. per passenger. From this it will be noted that by taking the average weight of a passenger as 160 lbs., which is rather a high figure, the steel car loaded to its full capacity will weigh no more per passenger than the empty wooden coach of the same length. The general dimensions of the car is as follows: Length over buffer face plates, 80 ft. 3¾ ins.; length over body corner posts, 70 ft. 5¾ ins.; length inside, 69 ft. 7⅜ ins.; width over side sheathing, 9 ft. 9¾ ins.; width inside, 9 ft. 1⅛ ins.

The general scheme of construction is to carry the whole weight of car on the center sills, which are of sufficient strength to resist excessive buffing shocks. These sills consist of two, rolled channels 18 ins. deep, spaced 16 ins. apart and tied together at top and bottom with cover plates ½ x 24 ins. This girder is set at such a height as to permit the draw gear to be placed between the center sills near their center line, thus providing that buffing and pulling stresses be transmitted in a direct line through the sills. The superstructure is carried by side girders formed of the side sheathing below the window sills with the side sill angle, 5 x 3½ x 9/16 ins, as a bottom chord and the belt rail forming the top chord, the latter is a special section of an area approximately the same as the bottom chord. This girder is stiffened vertically by the side posts which extend to the bottom of the same.

No body bolsters are used, the side girder loads being transferred to the center sills through the body end sills and two cross-bearers, they being located respectively the same distance in front and back of the center sill support or truck center, which produces a balancing effect of the transferred concentrated loads and obviates the possibility of any stresses coming into the superstructure by the deflection of the center sills. Each side girder is further tied to the center sills with eight 5-in. channels, which do not transmit any of the vertical loads, but act as braces to keep the side sill in line.

The floor is formed of "Karbolith," a non-inflammable material 1½ ins. thick, laid on top of corrugated steel sheets which are supported at the center sills and side of car. The sub or false floor is made of asbestos board bound with galvanized sheet steel. Composite board, a non-inflammable material, is used for the headlining at ceiling; the rest of the inside finish is of steel, having a layer of 3/16 in. Ceilinite, glued to the unexposed surfaces for the purpose of insulation. The outside finish, roof covering and steps are of sheet steel of from No. 16 to No. 11 gauge.

Four-wheel trucks with 5 x 9 in. journals are used. These are all-steel and of a special construction to accommodate the deep center sills, the lower surface of which are but 30 ins. from the top of the rail. The features of these trucks, in which they differ from usual construction are, the extension of the bolsters under these side frames; the location of the side bearings outside of the side frame, for the purpose of meeting the body side bearings which are under the side girder of the car; and the supporting of the truck bolsters which are hung from the side frame by hangers and gibs.



PENNSYLVANIA ALL STEEL COACH, BUILT BY THE PRESSED STEEL CAR CO.

Popularity of Certain Boys.

Those who have studied the ways of boys in shops and in offices are often moved to ask the question, what makes a boy popular? Surely it is manliness. During the war how many schools and colleges followed popular boys? These young leaders were the manly boys whose hearts could be trusted. The boy who respects his mother has leadership in him. The boy who is careful of his sister is a knight. The boy who will never violate his word, and who will pledge his honor to his own hurt and change not, will have the confidence of his feelings. The boy who will never hurt the feeling of anyone will one day find himself possessing all sympathy. If you want to be a popular boy be manly and generous.

Acquired Common Sense.

To substitute acquired common sense, knowledge and reflection for the cruder and tardier process of learning by hard personal experiences and mistakes, is, of course, the object of all education. In "From Sail to Steam" Capt. A. T. Mahan says that a student reciting, and confronted suddenly with some question or step in a demonstration, which he has failed to master, or upon which he has not reflected, is apt to feel that the practical thing to do is not to admit ignorance; to trust to luck and answer at random.

Such a one, writes Capt. Mahan, explaining a drawing of a bridge to my father, an instructor for many years at West Point, was asked by him what was represented by certain lines, showing the up-stream part of a pier. Not knowing, he replied: "That is a hole to catch the ice in." "Imagine," said my father in telling me of the story, "catching all the ice from above in holes in the piers!"

A little common sense exercised first, not afterward, is the prescription against leaping before you look.—*World Wide.*

General Correspondence

Derailment of Tenders.

Editor:

I have read the article in May number entitled "Derailment of Tenders," written by C. B. M., of Chicago, and note your request for readers who have had like experiences, and who might be able to throw any light on the subject, to direct same to your columns.

I will say briefly that on this road we had trouble with tenders derailing a good deal, both on straight and curved track, good and rough track alike, and at fast and slow speeds, while the trucks would be found to be in apparent good order. Now that this trouble seems to be a thing of the past, I will give your readers my opinion of what brought this change about, and think my reasons are valid ones.

The tenders are of 3,000 gals. water and 9 tons coal capacity, formerly with cast iron 28-in. wheels. Having several wheels break on the mountain, I changed all these wheels, putting in the "Krupp" steel tire wheels, and at the same time I changed the brake beams, putting in the inside hung steel beams, which are hung from truck bolster, while the old wooden beams were hung outside of wheels and in same manner as described by C. B. M., "from the tank sill with a hinge at top of hanger."

The brake beams hung in this manner, with the shoe below the center of wheel, exerts a "lifting force" when brakes are applied, and while in this position, with the tender rolling, either from bad track, or low water, or a top heavy load of coal, the brake being applied, would actually lift the wheel off the rail, with the motion of the tender rolling.

I have seen actual demonstrations of this "lifting force," as I will call it, where one pair of wheels were derailed with the brake on, this wheel passed over an open culvert and did not drop down, the brake carrying it to opposite side, and barely marking the tie at that end, which shows what a factor the brake so hung is in lifting the wheel off track, and derailing the tender.

The inside brake between the wheels, hung from truck bolster, is an entirely different matter, for now the truck is in no way connected to the tender outside of center castings, allowing the tender to roll with the brake on, and has no effect on the truck that would cause it to derail.

C. B. M. says that the coaches do not derail, that it is only the tenders. If my reasoning in the foregoing is correct, then it necessarily follows that the coaches do not derail for the reason of having brakes hung from frame of truck, and not from sills of coach; this arrangement allows the coach to roll without brakes lifting the wheels. I don't suppose that many coaches nowadays have brakes hung from car bottom.

I will add, in closing this article, that our derailments of tenders have ceased since the changing of wheels and location of brake beams, so it is reasonable to believe that our trouble was in the manner in which the brake beams were hung to the sills of tender.

W. S. Templeton,
Supt. M. P. & E. Central Ry. of Guatemala.
Guatemala City.

PETRIFIED WOOD LYING ON A SAND DUNE, SANTA FE ROUTE.

Frame Welding With Oil.

Editor:

I noticed in your May issue of Railway and Locomotive Engineering that Mr. Kellog, master mechanic So. Pac., at Los Angeles, Cal., claims to be the originator of oil welding, also showing sketches of frame ready for oil weld and that Mr. Voges, general foreman Big Four Shops, Bellefontaine, Ohio, wrote to Mr. Merry, general foreman, at Tucson, Ariz., for information and sketches of oil welding. I wish to place this matter in the right light and give credit to whom it belongs.

In regard to Mr. Kellogg being the originator of this process, he must be mistaken. I was the first man to use crude oil in this method for welding frames at Tucson, and Mr. Merry was my general foreman. I had gained my knowledge from my brother, who was then and still is foreman of the blacksmith shop on the Big Four at Bellefontaine, Ohio. This was Jan. 15, 1906, and if any one can show a prior date of welding by this method on Southern Pacific I would like to have him do so. Furthermore, the proposition that Mr. Voges wrote to Mr. Merry asking further information as to the method is very amusing to me when I happen to know that the reverse is true. I don't see why proper credit cannot be given to the Big Four shops for inventing this process; therefore, I cannot keep still and see those that learned from me claiming to be the originators.

I received sketches and information regarding frame welding from the Big Four shops, Bellefontaine, Ohio, several years before the date mentioned by Mr. Kellogg and on Jan. 15, 1906, successfully welding the first frame with this method on this system. My general foreman, Mr. Merry, Tucson shops, then made the remark that this was away ahead of Mr. Kellogg's method of welding frames. Mr. Merry then wrote to Mr. Voges for further information regarding frame welding and all the details. As I said before, this method was entirely new to Mr. Merry, and by far a better method than the one

employed by Mr. Kellogg, M. M. Bakersfield, at the time.

The sketch shown in your May number, with letter signed by Mr. Kellogg, M. M., Los Angeles, Cal., is identically the same as the original one which I introduced at Tucson, and Mr. Merry, general foreman, had several blue prints copied from it at the time. I beg to advise Mr. Kellogg that I still have the original sketches of same.

Trusting you will see the justice of giving me the space in your valuable journal to rectify this error.

P. Engels,

Foreman Sunset Blacksmith Shop,
San Antonio, Texas.

Editor:

Questions About Walschaerts Gear.

Instruction on special subjects by correspondence, and self help through the reading of technical books, are wisely and widely taken advantage of in this age of universal education, and while the beneficial results therefrom to those long past school age are evident in the general increase in efficiency of enginemen, and the value of instruction books is unquestioned, there is one weak point in the system of trying to impart knowledge through the unresponsive type, and that's it: the printed paragraphs are unresponsive; but the man who reads closely, between the lines, as it were, will find his questions anticipated and further light on the subject somewhere within the covers of the book.

The Walschaerts valve gear, although extremely simple in principle, seems rather confusing to some students of that motion when any change is made from the original design with which they were familiar, and the suggestion that closes the preceding paragraph is exemplified by the question from a correspondent of this journal, an engineer who has read and remembered a portion of page 62 of the book "The Walschaert Valve Gear," written by the author of this article, as follows:

"With engines of the American type you can always tell, therefore, whether an engine with Walschaert's gear has outside or inside admission valves by noticing the position of the eccentric in reference to the main pin, and the method of connecting the valve-stem and radius rod to the combination lever." This follows a description of the general American practice in the designing of this gear of placing the eccentric a quarter ahead of the main pin in connection with outside admission valves, and a quarter behind the main pin with valves of inside admission; but, if the correspondent had read carefully the preceding pages, he would have found on page 49 the following:

"While the foregoing covers the standard method of application of the Walschaert valve gear by American locomotive builders, there are variations, and referring to Fig. 8, it is seen that Auchincloss, whose book on various valve motions is considered an authority, sets the eccentric a quarter behind the main pin, instead of ahead of it, as is usual with outside admission valves; but he reverses the effects of that change by carrying the link-block (and radius rod) at the top end of the link when the engine is to run forward."

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION IN SESSION AT ATLANTIC CITY, JUNE, 1908.

The engineer referred to was puzzled by the seeming discrepancy between the paragraph first quoted and the fact that on a Decapod engine he had observed the eccentric to be located a quarter ahead of the main pin, with inside admission valves; but if he had noticed the Decapod more closely he would have seen that common American practice was there reversed in that the radius rod was carried at the top of the link in forward gear. It is inadvisable to begin a book at the middle, quit reading it, and comment thereon without realizing that there may be modifications to any statement that may have caught one's attention. Further along, in the division of questions and answers, on page 161, occurs the following:

JOSEPH DIXON CRUCIBLE CO.'S EXHIBIT AT ATLANTIC CITY.

"Q. 26. With the reverse lever in forward gear, the radius rod is carried at the lower end of the link, and in back gear at the upper end of the link, is it not?

"A. Yes, this is American practice, but it can be arranged otherwise if more convenient, and will make unnecessary the multiplicity of levers in the reversing gear that is sometimes seen where the above arrangement is adhered to. The radius rod may be carried in the upper end of the link to make the engine run forward, and at the lower end to run backward, and in such cases it is only necessary, for further change, to move the position of the eccentric 180 degrees—from a quarter ahead to a quarter behind the main pin, or vice versa."

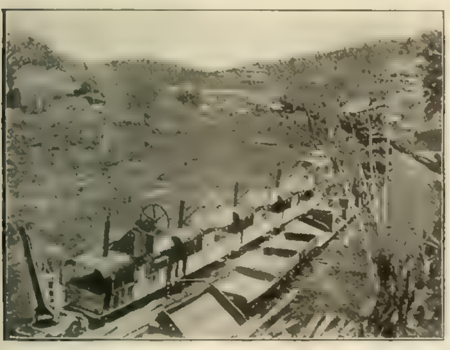
I think this can be made quite plain to your correspondent. The Walschaert link is suspended from an exactly central fulcrum pin, and the top end and bottom end are swung an equal distance, and the same distance all the time, by the single eccentric connected at the lower end, and through the radius rod and valve-stem the link gives the long, or main, travel to the valve. Imagine the eccentric to be at the top quarter, directly above the center of the axle—and the link-block and radius rod at the bottom of the link; now, there is, mechanically, a straight line of motion from eccentric to valve, and if the wheel should begin to turn in a forward direction the eccentric would move forward, the eccentric rod would move the lower end of the link forward, and the radius rod would push the combination lever, valve-stem and valve forward.

And suppose we wanted the valve to move forward; if it was of inside admission we should, if the main pin was on the forward dead center, so we will suppose

these things to be as suggested, and the valve moves forward as it should. But, suppose again, that for some very good reason we want to carry the radius rod at the top end of the link, instead of the bottom end, when the engine runs forward; we will raise the radius rod to top end of link, and find that as the eccentric moves ahead the radius rod, valve-stem and valve will be drawn backward instead of forward, the change has exactly reversed the travel of the valve, and the remedy is to reverse it again; this can be done by changing the position of the eccentric from the top quarter (a quarter behind the main pin) to the bottom quarter (a quarter ahead of the main pin). Isn't it plain? After making this double change imagine the wheel turning forward; the eccentric and lower end of the link moves backward, and the upper end of the link and radius rod moves forward, pushing the combination lever, valve-stem and valve forward, the front admission port opens from the inside of the front valve-piston, and the main piston in the cylinder starts under steam pressure to turn the main pin on its down-backward stroke.

Of course, with outside admission valves such double changes are made in the same way. When it is considered necessary and the running position of the radius rod is changed to the opposite end of the link, the eccentric location is shifted 180 degrees—to a point on the wheel directly opposite.

And thus is the adaptability of the Walschaert valve gear exemplified. The big Erie Railroad engine of the latest Mallet type, that was described and illustrated in the September, 1907, number of Railway and Locomotive Engineering, is a special representative of the advantages that may be obtained from the use of this gear, and may be taken to illustrate the text of this article. In the sectional side elevation, page 422, all crank-pins of both the front



OLD FRENCH MACHINERY ON THE CANAL ZONE.

and back "engines" are on the lower quarter, although but one is shown—the main pin of rear engine—and, odd as it may appear to the uninitiated, while the forward engine has outside admission valves, and those of the rear engine are of inside admission, the eccentrics of both engines are a quarter ahead of the main pins. The gear of the forward engine conforms to regular American practice of dropping the radius rod as the reverse lever is thrown forward, and with its outside admission valves the position of the eccentric in relation to the main pin is the common one; but on the rear engine, it will be noticed, throwing the reverse lever ahead raises the radius rod; it is contrary to common practice, but, "there's a reason," and that reason is that with the movement of the reverse lever dropping one set of rods, levers, etc., while the

M. C. B. ASSOCIATION HOLDING JUNE CONVENTION AT ATLANTIC CITY, N. J.

mate to it is rising, the weights of the operating parts are equalized and it gives a nice balancing effect, dispensing with the use of counterweighing springs.

The elevation of the radius rod to the top of the link in go-ahead gear would make the inside admission valve of the rear engine have a contrary travel, only that the designer has shifted the eccentric also, and instead of being a quarter behind the main pin he has placed it a quarter ahead.

But there is one unfailing way to tell whether a valve—say a piston valve—is of inside or outside admission that is not affected by any changes that may be made in the rest of the gear, and a way that makes it unnecessary to figure on the relative positions of reverse lever and radius rod; and that is the manner of connecting the valve-stem and radius rod to the combination lever, as referred to by the correspondent. Always with outside admission valves the valve-stem is the top connection to the combination lever; and always with inside admission valves the radius rod has the top connection: because the short motion given to the valve by the combination lever is only to provide the lead, and as the valve must be advanced in exactly opposite directions for the lead as between those of inside and those of outside admission, the arrangement of the connection to the combination lever is permanently decided by the style of valve—whether the valve contains live, boiler pressure or the exhaust chamber.

W. W. Wood.

La Fayette, Ind.

Suburban Service Power.

Editor:

I inclose photographs of some up-to-date motive power on the Boston & Albany division of the New York Central lines, which would, perhaps, be of interest to some of your readers.

The first is a picture of one of the six coupled double enders, built by the American Locomotive Co., and placed in service in January of the present year.

They have a straight top boiler 80 ins. in diameter, with a wide fire box 92 ins. long by 82 ins. wide extending back about midway in the cab. The cylinders are 20 ins. in diameter by 24 ins. stroke, while the valves are of the piston type with $5\frac{1}{2}$ ins. stroke, operated by the Walschaerts Valve Gear. On this locomotive the valve rod guide extends from the valve casing back to the guide yoke and is bolted at both ends, the end nearest the guide yoke being lowered slightly so as not to interfere with the radius rod, which extends back of the link and is suspended at the rear end. The link is of the built up type and the link bearer is fastened to the back of the guide yoke. The reversing shaft bearings are also bolted to the guide yoke while the combining lever is placed in front of the cross-head. The driving wheels are all flanged and are equally spaced, being 62 ins. in diameter. The tank is of the water bottom pattern,

extending under the cab floor nearly to the back of the fire box and is supported by a six-wheel swinging truck, There are two types of these engines, some with the Stephenson valve motion, which were put in service in December, 1906, and the later ones have the Walschaerts gear.

SUBURBAN TROLLEY CAR.

They are used for the suburban traffic on the Newton circuit where they are called upon to haul heavy trains and make frequent stops.

The other two pictures are of the electric motor car which is operated on the Newton Lower Falls branch, which extends from Riverside to Newton Lower Falls. This car is the same as the standard N. Y. C. coach and is divided into passenger, baggage and smoking compartments. The electric eqnipment consists of two 125 h.p. motors suspended on the truck under the smoking compartment, using a direct current of 550 volts. There are two controllers, one on each end of the car, of the automatic type, equipped with the safety button on the controller handle while the contactors, resistances and the reversing mechanism are all placed beneath the car. The power is transmitted to the motors by means of two trolleys, one at each end, only one of which is used while the car is in motion, the other being held down from the wire by a hook on the roof, until the car is run in the opposite direction when the trolleys are changed. The car is heated and lighted by electricity. Compressed air is used for the brakes and whistle and is furnished by a motor driven air compressor underneath the car floor and the air storing tanks are also located there.

Waltham, Mass. T. S. Wyman.

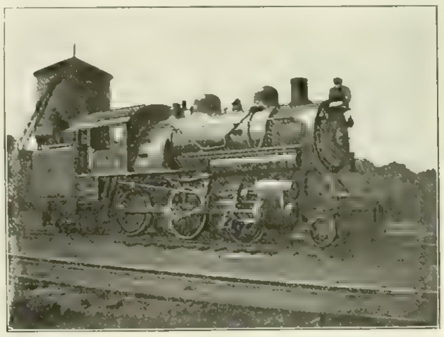
New Things Adopted Slowly.

Editor:

I have been reading your journal and consider its articles on the method of running a railroad from every point of view to be the best common sense and good for both the railroads and railroaders; therefore, I want to get your advice about the introduction of some new devices. One is a draw gear device and the other is a knuckle pin fastener for rods of locomotives.

I know from experience how hard it is to get superintendents of motive power to look favorably on new things, as, for instance, it took years to displace the wooden shoe on truck breaks. The cry was that iron would not hold. It took 35 years to displace the side pumps on locomotives; they said the injector was not reliable, although the injector came out in 1859; still Wm. Mason, in 1868, used to put side pump on right side and an injector on the left side and it was hardly ever used. In 1868 I knew an engineer to be discharged because he put a small coil of lead among hemp packing to pack his valve stem.

The Dunbar cylinder packing was an improvement, but still they stuck to the old block packing that would fall down every trip and have to be set out or the engine would stand and blow; for that matter, standing or running, they were blowing and wasting steam. After the steam gauge was put on, no one had confidence in it; the engineer, when the engine was not blowing off, would take hold of the stillards and raise them up to find out how much steam he had before he would start. When the foot-cock



N. Y. C. SWITCHING ENGINE.

was put on engineers would not use it, preferring to regulate the feed water with a chip to raise or lower the tank valve and, by the way, in this manner they too could pump an engine very freely. This would not do now. Well, you know how some people used till lately to shrink a tire on and then put four ¾-in. rivets through the tire and rim of wheel, and rivet them hot.

Still they put keys in to key the wheel on shaft, a fad; a key there is of no more use than the fifth wheel to a wagon. It might be of some account in Peter Cooper's engine when he used wooden spokes. Again, you know how hard it was to introduce cylinder lubricators, or sight feed. The real thing was to wait till you struck some long down grade, then the fireman would run out to the steam chest and pour the tallow in while the engine was drifting, and as almost all throttle valves leaked, the poor fireman when he opened the cock to oil the valve would get his face burnt with steam and water. After a long time this was improved by a cab oiler, that fixed it. The drop feed had to wait. Well, the blower, though it was offered, it was relegated to the rear till about 1857. It was claimed that the blower was detrimental to the flues. I never could reason why.

It took years to get the center beam truck introduced. All those great improvements had a long hard struggle to get recognition.

Bloomington, Ill. M. Kelly.

Bank Firing of Bituminous Coal

Editor:

I desire to reply to an article entitled "Bank Firing of Bituminous Coal," printed in the June, 1908, issue of Railway and Locomotive Engineering, in which the writer, Mr. R. G. Donaldson, advocates the bank firing method of firing wide firebox locomotives.

In advocating this method and pointing out its probable advantages, Mr. Donaldson presents his views in an able manner. However, I beg to differ from most of his opinions relative to bank firing. Not only because it is inconsistent with the principles of firing taught by men recognized as authorities for their knowledge of both the science and combustion and its practical application to firing, but because we ourselves came to the conclusion as a result of experimenting and also observing the several methods of firing practiced by our firemen, for the purpose of determining the method best suited to our requirements with the view of making it effective as a rule for firing; that bank firing gives results in every way inferior to the level fire; that it necessitates the use of more fuel, causes the emission of more smoke and does not maintain the steam pressure as constant as the level fire.

It not only was long ago realized that the commercial rate of combustion per unit of grate area had been exceeded with the narrow firebox locomotives, but that the steam demanded of this type of locomotive for sustained speed or tractive effort required a rate of combustion impossible to attain, and the introduction of wide firebox locomotives followed as a natural sequence. Yet, there is a great number of firemen that practise—and quite a few that defend the practice—a method of firing wide firebox locomotives that virtually reduce their grate area; in some

CAR FOR SUBURBAN TRAFFIC.

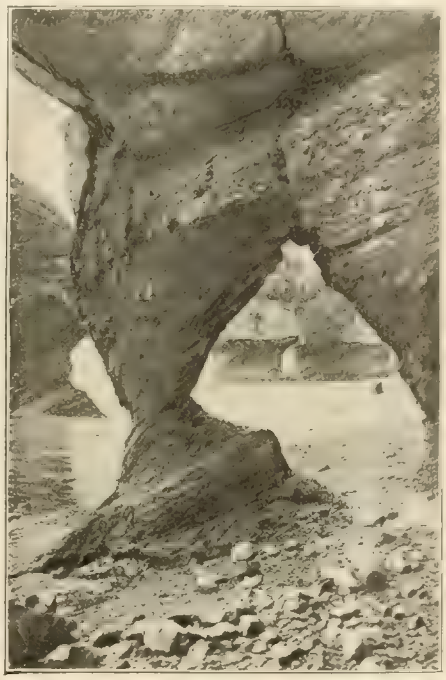
cases to an area less than the narrow firebox locomotives had. A mass of unburning fuel acts as a damper, and so the bank of coal used in bank firing, which is a mass of unburning, or at the best poorly burning fuel, and not coke as some claim, certainly reduces the grate area to the extent of grate it covers, and thus defeats the very objects for which the wide firebox was designed.

Bank firing produces firebox conditions that presented graphically show some interesting features, and a study of their character should make the deficiencies of this method clearly apparent. The bank produces a distribution of air and gases that is not conducive to ideal conditions required for combustion. For it should be remembered that a thorough mixing of air and hydrocarbons is not the only requisite for their ignition, but that it is positively essential that the mixture be heated to a temperature of 1,800 degs. F. before combustion can take place; and even should the mixture be heated to that temperature it still must have flame way, that is, both time and room to burn before coming into contact with the comparatively cool heating surfaces of the boiler, or it will chill and combustion will be arrested.

When the firedoor is open during the act of firing, the distribution of air and gases form a strata of three layers. Some air forces its way through the thin fire in front, and the resulting gases flowing to the lower row of tubes form the bottom layer. The large volume of air entering the open door is deflected upward by the back slope of the bank—not sprayed and mixed with the volatile gases, as advocates of this method claim—and flowing forward along the crown sheet forms the top layer. This acts as a comparatively cool blanket to both the heating surface of the firebox that it comes in contact with, and to the middle layer, which consists of the volatile matter expelled from the smoldering front slope of the bank flowing in the state of smoke to the middle rows of tubes: absorbs useful heat from the water in the boiler, and lowers the temperature of the middle layer's constituent gases which prevents their ignition. When the firedoor is closed the distribution is changed, though the conditions are not improved. The tightly shut firedoor and the thick bank of fuel at low temperature prevent access of sufficient air at high temperature in the back part of the firebox, and results in forming considerable carbon monoxide that probably passes to the tubes in this state; as its conversion to carbon dioxide can hardly take place in the short flame way of the hot region over the thin fire in front.

This loss of combustible gases and consequent loss of heat necessitates an intense draft through the grate, its production making obligatory the tightly shut firedoor, a characteristic feature of heavy or localized firing, because nearly all of the required heat must be generated from the solid matter burning on the front part of the grate, and also because a strong draft is desired to drag forward from the front slope the fuel, which, on account of the caking properties of bituminous coal when fired with heavy applications, must frequently be broken up and assisted with the use of firing tools. This burning of so much solid matter on the front part of the grate also results in the deposit at that place of an excessive accumulation of ash and clinker, as these non-combustibles are associated with the solid matter of coal. The great disadvantages of this are obvious and need no elaborating here.

Clinker, by the way, is not formed by the puddling action of either lumps of coal falling with force on the surface of the fire or the use of the hook; nor is it ever formed at the surface of the fire, but always underneath. Clinker forming substances are associated with the solid matter of coal, and consist, in the greater part, of silicates and pyrites, which at a very high temperature fuse, and percolating the burning fire, mingle with the comparatively cold ashes beneath, bind them together and solidifies, thus forming the cakes of hard matter called clinker. Localized or heavy firing is productive of more clinker than an evenly burning fire, because in order to generate in the aggregate a given quantity of heat the maximum temperature required of a fire burning in spots naturally must be higher than the more uniform temperature of an evenly burning fire; as such fires burn through in holes or spots that have a sort of blowpipe action which generates intense heat, and if their temperature is higher than the fusing point of clinker forming substances, these melt and form clinker as previously illustrated.



ROCK NEAR MONCTON, N. B., ON THE INTERCOLONIAL.

Locomotives that operate regularly under conditions of service that impose a rate of combustion per unit of grate area less than considered economical, can have their grate areas reduced by a plan more efficient and comprehensive than heaping a bank of coal on the grate. If a reduction of grate area becomes desirable the front part of the grate should be blanked, which can be done by bricking off the undesired grate. In fact, this is done on a great many Pennsylvania Railroad locomotives running on some of the level, Eastern divisions, and it is believed that it results both in effecting a saving of coal and reducing the volume of smoke emitted. Indeed, this plan of reducing excessive grate area commends itself as desirable and one worthy of experiment on broad lines to determine whether or not it might prove a paying idea if applied to the greater number of wide firebox locomotives, even if it should increase to a limited extent the rate of combustion on the grate; as it improvises a combustion chamber with all of a combustion chamber's advantages and without some of its disadvantages, and it is probable that the loss due to a slightly increased rate of combustion would be more than offset by the benefits obtained from better combustion which results in improved boiler efficiency.

Localized high temperatures in the firebox should not result in serious injury to the boiler; provided the boiler is properly designed, and that provision is made for free circulation of water to the heating surfaces. Of course, the effect of high temperature causes boilers to deteriorate, though the effect of expansion and contraction of boiler sheets due to the varying temperature of the surrounding water is really destructive, and is the cause of most boiler troubles. This varying of temperatures can be controlled to a great extent by regulating the feed water and fire so as to maintain a constant steam pressure, which will maintain a constant temperature; because water and steam in a boiler have a temperature due to the pressure of its steam in a saturated state, and a variation of pressure causes a corresponding change of temperature.

Motive power officials do advocate, logically too, level firing. A better phrase would be "a uniformly burning fire." They do not claim for it though, that it obtains all of the conditions required for complete combustion; but their experience and observation has taught them that it produces conditions more nearly ideal than any other known method so far. It does, perhaps, require more skill than some other methods, particularly bank firing, for it certainly does not require the exercise of much skill to throw coal just over the apex of a heap, allowing it to roll down the other side.

The introduction of bank firing and other hit or miss, shipshod methods, and their practice, antedates the advent of the wide firebox, as they came into vogue

about the time the use of the brick arch was generally abandoned. The use of the brick arch does not permit their practice, and if the brick arch serves no other purpose, it serves this one well: it makes imperative the practice of skillful firing. Looking at the matter from this point of view, abandoning the brick arch was a mistake; for it is generally understood that careful and skillful firing, in conjunction with skillful operation of the locomotive, is the prime requisite for fuel economy, and if the brick arch enforces the practice of skillful firing a return to its general use is desirable, for the resulting benefits would more than compensate for the grief and expense incidental to their maintenance.

It is a deplorable state of affairs that even suggests the thought that coercive measures should be necessary to induce men to strive for high efficiency in their respective callings, not to speak of observing the rules and regulations instituted for their information and instruction; yet this seems to be the actual condition that confronts the motive power department of every large railroad to-day, and any appliance, device, or imposed system of firing that will impel firemen to think for themselves and use brains in their work is worth more than a trial.

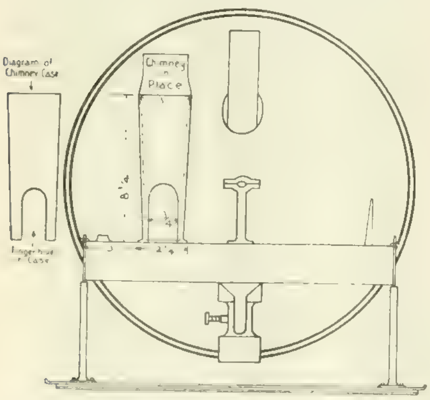
In concluding, I may say that I would be glad to elaborate on our rules for, and our method of firing, but the fear of imposing on the editor's hospitality forbids, though with his permission I may do so at some future time.

Clarence Roberts,
Instructor of Firemen, Phila. Term'l. Div.,
Pennsylvania Railroad.
Philadelphia, Pa.

Extra Chimney Holder.

Editor:

Considerable difficulty has been experienced in finding a suitable place on a locomotive for carrying an extra headlight



HEADLIGHT CHIMNEY HOLDER.

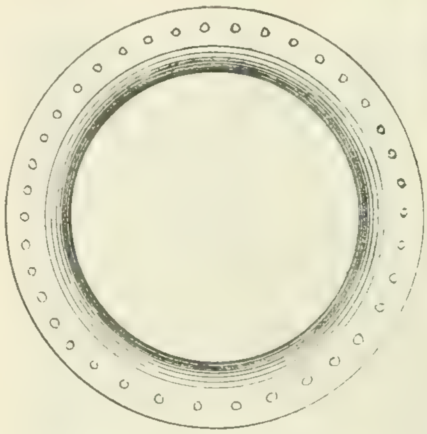
chimney, so that same could be had quickly when required. When carried in engineer's seat box, they were often broken by articles thrown on the chimney, or by the lurching of the engine. To overcome this difficulty an extra chimney holder has been designed, as shown on the drawing. It is attached to the headlight so that same can be had for instant use when required. This holder has proved a great success and has greatly reduced the number of headlight chimneys broken since its adoption.

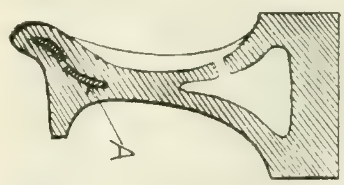
O. Bendill.
Boone, Ia.

Proposed Wheel Flange.

Editor:

I inclose sketch, which is subject to discussion by the readers of your later issues, and I would like to know the opinions of others, and ask you to publish my idea when you have space. I was recently reading the difference in power required to break off piece of wheel flange in cast iron and Shoen's pressed steel wheels. Undoubtedly the manufacturing of Shoen's wheels and common cast iron





PROPOSED STRENGTHENING OF FLANGE.

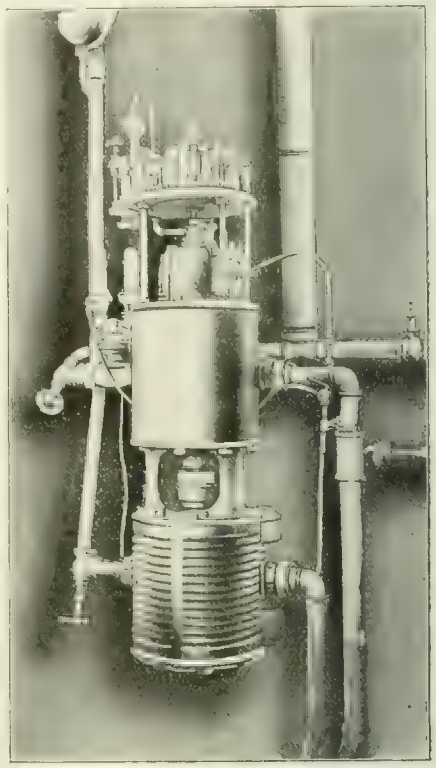
wheels are the cheapest, while the pressed steel wheels are the strongest, safest and of longer life. My idea is a compromise between the two, and consists of a ring made of boiler steel or iron plate, say ⅜ of an inch thick, pressed into the shape shown at A. One row of holes are punched all round to permit the iron to flow into and make a better tie between the ring and wheel. Before the mold is closed and before pouring, the ring is placed in mold and anchored so that the cast iron will evenly divide both sides of ring. I think the chill on the tread of the wheel will be increased and deeper, as the cooling process will be increased from the ring. If the flange should break off or crack, I believe it would remain on and be kept in its place by the ring. The idea, however, may be worth talking about.

C. Wilhelmsen,
Master Mechanic.
Kentwood, La.

Air Pump With Exposed Valve.

Editor:

Inclosed please find photograph of 9½-inch pump in air room at this place. It is equipped with sectional steam head



AIR PUMP WITH TANDEM VALVES.

with reversing valves working in tandem, and main valve pistons connected by rigging. Shop line is piped through air cylinder and Duplex governor is used to control pressures. L. P. head is set at 90 lbs. for test racks, etc., in air room, and H. P. head is set at 120 lbs. The latter is used when air is cut into line connected to large air hoist used in loading and unloading fireboxes, cylinder saddles, etc., on transfer track.

A. E. Nye,
Air Room Foreman, A. T. & S. F. Ry.
Alberquerque, N. M.

Superheated Steam Lubrication

Experiments have been made at the the University of Liverpool, England, with a view to determine the best method of lubrication in using superheated steam. Much difficulty has been experienced in properly lubricating the internal rubbing parts. The steam admission valves present the greatest difficulties. It was readily demonstrated that fractional distillation of the oil took place; a pitch-like residue being deposited in a receiving chamber. From an engineering point of view, the experiments were disappointing, inasmuch as little or nothing has been learned about the lubricating properties of the oils. In such cases experiments in actual service seem to be more valuable than those conducted in the laboratory.

Papers Presented at the General Foremen's Convention

Topic No. 3, which was on the programme of the International Railway General Foremen's Association, was entitled "Reporting Work vs. Engine Inspection—should either be discontinued or are both essential?" The report on this important subject was not printed and was consequently not read at the convention held in Chicago last May. It is to be hoped that the subject will be taken up next year.

TOPIC NO. 2. MODERN SHOP CONSTRUCTION—CROSS PITS OR LONGITUDINAL. LOCATION OF WASH ROOMS AND LAVATORIES—BEST LOCATION FOR EACH DAPARTMENT.

In bringing out a paper on this subject the writer believes that the machine, boiler, blacksmith shops and round house should be considered as to their location to each other and the equipment of same, so as to give the largest output most economically.

The buildings should be large enough to take care of the division system. On about one-half of the railroads in this country you will find the shops and round houses entirely too small for the volume of business done, and in consequence it puts the round house and all other foremen at a decided disadvantage.

The shops should be equipped with a suitable number of traveling cranes; no shop is modern without them.

As to cross pits or longitudinal pits there is no doubt in my mind which is preferable; with the cross pits the engine can always be taken in and out of the shop without any delay; can also be transferred to and from the boiler shop without causing a delay to any engine in the machine shop. With a longitudinal pit it would be necessary to transfer the men on to other work until the engine desired to be shifted was out of the way and the rest put back in their places. With cross pits the work is centralized for the machines.

Herewith a sketch showing the location of the different shops, which I think would be a modern affair, with the blacksmith and boiler shops in close proximity to the round house, all running repairs to engines could be handled expeditiously. As a general thing you will invariably find these two shops especially tucked away in some remote corner of the shop yard, or else occupying a valuable corner in one of the larger shops. The machine and boiler shops should be wide enough so that the machines could be placed on one side, in such a position as will be most convenient for the class of work intended for them, and still leave ample room for the handling of flues taken out of the boilers, without opening the doors or interfering with the machines or the placing of material at the machines. Only light boiler work should be done in the machine shop; heavy work interferes with the work of the machinist, and I know that the company does not receive the capacity of the shop if the machinists are compelled to work in the continuous noise made by air hammers and general or heavy boiler work.

It is also very important that the shops be well ventilated and lighted. Money spent in extra windows is a good investment and gives more returns than figures can tell. Another very important thing is to keep the shops well cleaned at all times; I believe it is economy for the company to employ enough sweepers to keep the shop clean and in good order at all times; as cleanliness is next to Godliness, it is the prime mover in the shop as well as the office; the man in overalls, either at the vise or on the machine, appreciates your endeavors in that direction and will show it in the work performed.

There should be ample room between the pits for work benches placed parallel with them, for it is more convenient to do the work on the engines with benches in this position than if they were placed at one end or against the wall between the doors. The benches should have racks in the centre to hang pipes and other material on, and have a suitable number of drawers for the men to keep their tools handy for the work; if the benches are built right, there will be enough shelf room so that all small pieces from the engine can be properly taken care of and kept off the floor, and the very small pieces can be placed in the drawer, properly tagged, ready for immediate use when the time comes. There should be at least four vises to each bench, two on each side, spaced alternately. The lights should be placed in the center of the benches, lengthwise, in clusters. I find that three four-light clusters on each bench gives a good light. The wiring should be done so that each bench cluster could be turned on or off at will; suitable places provided for attaching extension plugs; these give better satisfaction than candles or torches. I also believe that each machine should have one or two incandescent lights; one should have a flexible connection so that the workman can adjust it to the best advantage in doing his work.

In having a modern shop we must not lose sight of the very imporant factor of having modern and up-to-date machines. The best are none too good. Experience has taught us that there is no investment which pays better dividends than to discard the old machines and replace them with new, up-to-date, high duty ones; we also know that when the company erects an up-to-date shop, they expect in return an up-to-date output, and this cannot be accomplished on old antiquated machines. Labor, at the present time, is very expensive, and the difference in time used in doing a job on the old style machines to what it can be done for on the best tools, will show an enormous saving in cost of output, to say nothing of delay time to the erecting floor. A small traveling crane should also be installed over the machines to serve them; this would also increase the output.

The tool room should be placed in the centre of the shop, lengthwise, and a full supply of tools kept constantly on hand, so that no delay would be caused by waiting for tools. A competent man should be placed in charge whose duty would be to see that all tools, wrenches or appliances were returned to the tool room at the end of each day; to have repairs made to such tools which had become broken or damaged; to keep an accurate account of the condition of all contained in the room, and to know who gets the tools from the tool room. This should be done by a system of checks.

Another very important feature in modern shop construction is to provide the shop foreman, shop superintendent, erecting foreman or by whatever title he may be called, with a suitable office in some central part of the shop and built in such a manner that he could glance from one end of the shop to the other without moving from his work. While I believe that this same foreman should spend his time among the workmen, there are times when considerable office work falls to his lot and this must needs be done in a clean, comfortable place. This office should be supplied with telephone connections to all shops, thereby saving the foreman many extra steps and the company many dollars paid out in wages to those who would take advantage of his absence and spend a "fiver" or two telling his fellow workman what a nice time he had at the dance last night. He should have convenient shelves and drawers built inside the office; the shelves for mechanical books and catalogs; the drawers for blue prints laid flat; some smaller drawers for correspondence, of which, in his career with the company, a great deal will accumulate. A good, clean office, dust proof and sanitary, supplied with wash bowl, adds dignity to his position and he may command more respect from the workmen under his charge than if the company furnished him with an open affair in some remote corner of the shop, or nailed up a board along the side wall just about large enough for him to write shop orders on.

Wash rooms and lavatories, if there is ample ground room, should be placed conveniently near the shop, plentifully supplied with wash basins and lockers. Towels and soap should also be furnished by the company. Sanitary metal lockers are

the only kind I would recommend, and these should be placed on the same floor with the wash bowls. If there is no ground space available, they should be suspended from the roof. A man placed in charge who would keep it clean, clothed with authority to keep out loiterers.

As to the handling and storing of materials, I can say very little at this time. This subject is a live one and should have been by itself. The method employed by the Duluth & Iron Range Company is a good one, but can be improved upon, for no system is perfect. I will leave this question open for discussion.

LUTHER H. BRYAN,
D. & I. R. R. R.
Two Harbors, Minn.

TOPIC NO 2, CONTINUED.

As many of the members of The International Railway General Foremen's Association are interested, principally in the working of a shop after it has been constructed, the discussions which will follow will be naturally on that line; thus this paper will be confined to that feature.

It is said of a certain manufacturing plant which builds many locomotives, the two principal factors, proprietors and constructors, were diametrically opposite in their methods. One would adopt methods, ways and means used by others in the same business to improve constructive methods and finished output; while the other one must have something original. It was said that they made a good team and rapidly improved on their own construction, and were foremost in the race to bring to the present, almost perfect state of usefulness, that "monster," which brings the products of one part of the hemisphere to the doors of the users thousands of miles away and trading the commodities of one locality for that of another, building up a commerce, that will survive even the "big stick," or the "big slipper," as it has been recently called.

The construction of the modern locomotive repair shop, which has gradually evoluted from the primitive "back shop" and which was accessible only from one or two of the various round house stalls, usually placed in front of it (hence back shop) or perhaps from a track or two located so fuel and material on the cars which came off the road, could be run to the rear of the blacksmith shop, which was generally located in the rear of the erecting and machine shop.

From this gradually worked out the idea of a second turntable, other than the one at roundhouse proper, with its tracks leading to the various parts of the back shop, with the machine shop in turn located along the ends or terminals of these tracks.

It was then found that a track was necessary to transport material from these tracks, longitudinally, with line shaft from which the various machines were driven and conveniently located. The material was stripped from the engine, dragged out on little wagons and carts of every design imaginable, until it reached these tracks, where it was loaded on trucks and run either to the machines or to a dirty corner of the shop, (later a lye vat), where it was cleaned and run to various departments.

This is old and uninteresting history to most of us; but it leads us to the point where the educated sons of the principal stockholders and prominent officials came in to help take care of the vast properties of their sires. Later, this property was to become their own and must be taken care of and run in such a way that a fair return on money invested would result.

These gentlemen found that it cost money to jack up even a forty-ton engine, place it on blocks, high enough to run large diameter wheels out from under cylinders, which hung down from the frame and boiler and which were getting larger and even added to by reason of compounding. These would hang down still further as new and more modern equipment was purchased and were more and more in the way of removing driving wheels until the result was, that engines were blocked up so high and required so much good blocking, heavy to handle, and in the way when in use or not in use. They were so high after being raised that it was dangerous to go near them and also much less convenient to do work on them. After the wheels were out, they must be turned quarter around when they got to the tracks, which served the machines for turning tires and did other necessary work.

It also cost money and required the time of a high-priced foreman to chase up and down, through, between and around these engines, and stir up lazy and indifferent workmen and some alert apprentices and helpers, to get material off the engines to proper places for treatment and back to place again.

It was thought quite the proper thing to provide transfer jacks and communicating pits, so the wheels could be removed, by merely setting jacks under each end of the frames, taking the weight and removing one wheel at a time, placing the frames and boiler on temporary wheels and axles. The engine was then moved along until all wheels and trucks were out and then the engine was switched to other tracks until ready to wheel again. This involved expense, a switch engine was not always available and it cost money to pinch engines. Where? Why out to turn table, of course, and then back again on some of the available tracks. Better build a transfer table, then we would not have to pinch it so far, put a small pair of reversible engines on the table with a rope hauling device. By this means, the engines were pulled out and in turn pulled in again on the unused track, the men who did the pinching could be sent to where tires were removed and applied and set to doing that work, but that is another story.

Now, by this time the sons of these sons of their fathers were coming out of their technical training schools with new and improved ideas. Now, the discussion is fairly on, competition has begun. Engineers of shop construction have come into the field. Experts are employed and large contracting firms have developed systems and have on hand plans of shops of recent construction which are operated with economy at various places and which cover different conditions and are suited to the localities where some have been built or contemplated.

Take your choice, gentlemen, recently constructed with transfer tables and transverse pits. Out of twenty such and such shops shown in "Railway Shop Up To Date," recently compiled by editorial staff of the Railway Master Mechanic, fifteen of them show one or more transfer tables which are used to place engines in and out of erecting shops. This would necessarily make the locomotives stand on cross pits. But five of these have track approaches to erecting shop and must therefore call for longitudinal pits. Some of both of the mentioned are car shops, but must, of course, handle material and distribute it to proper places.

The locomotive shop which is the most important in this discussion is elaborately treated on pages 36 to 73. One of the contributors to this treatise, compiled by Railway Master Mechanic, Mr. R. H. Soule, who stands at the head of authorities on railroad shop construction and who was originally chairman of the committee on shop lay-outs, who reported their findings to the American Railway Master Mechanic Association, 1905.

He sums up the situation very concisely in nine items, which cover almost every phase of the situation. I have copied them.

Item 1. "The longitudinal shop can be placed parallel to a general line of tracks and entered by direct track connections, while with the transverse shop, if placed parallel to a general line of tracks, it must be entered by a turntable.

Item 2. From a structural standpoint, the distance between roof trusses over erecting floor in the longitudinal shop can be determined by conditions of economy alone. In the transverse shop this distance must be the same as spread of stall tracks, whether economical or not.

Item 3. The longitudinal shop is less compact and the transverse shop more compact.

Item 4. Considering access from shops, in the longitudinal, traffic must be across the pits. In the transverse shop it is not necessary to cross pits.

Item 5. Lighting, both day and night,

is more difficult in the longitudinal shop and in the transverse shop is easier and better.

Item 6. In lifting engines in the longitudinal shop, it is necessary to lift them only high enough to clear driving wheels, consuming less time, while in the transverse shop engines have to be lifted enough to clear adjacent engines, consuming more time.

Item 7. In moving engines horizontally in the longitudinal shop, less distance is covered under average conditions. In the transverse shop more distance is covered under average conditions.

Item 8. In dropping engines on their wheels in the longitudinal shop this work includes more use of cranes and less manual labor (in handling wheels) while in the transverse shop this work is done with less use of cranes and more manual labor.

Item 9. As a summary of these various points, greater flexibility is attributed to the longitudinal shop and less to the transverse shop.

In discussing these several items, Mr. F. F. Gaines, then mechanical engineer of the Philadelphia & Reading Railroad, argues as follows:

Item 1. The first item may be stricken out from general consideration, as it applies only to localities where the ground space is limited and governs a design rather than the general utility of the shop itself.

Item 2. From data given in report it is seen that the width of bays necessary with either class averages nearly the same, being sixty-five and one-half feet for the longitudinal, sixty-three and one-fourth feet for transverse with cranes on two levels.

Item 3. Admits desirability of transverse arrangement.

Item 4. Admits desirability of transverse arrangement.

Item 5. Admits desirability of transverse arrangement.

Item 6. Lifting Engines: Unless at all times the middle track of the transverse shop is kept open, or sufficient space between the tracks is left for standing an engine, it will be necessary to lift engines over other engines, either to bring them in or take them out. If the middle track is kept open or space between the tracks is allowed it becomes a very uneconomical distribution of floor space. On the other hand, granting it takes more time to lift engines in a transverse shop, which is questionable, the amount of such time is small and affects only a very small percentage of the force.

Item 7. For the same reasons as given under Item 6, it is questionable if it is at all favorable to a longitudinal shop.

Item 8. If the work is handled properly there is absolutely no difference in either system, in either time or manual labor.

Mr. Gaines adds two items not included in Mr. Soule's summary, which cover the distribution of material. One refers to access to machines and movement of men to and from tool room, and it is decidedly in favor of the transverse shop arrangement; and the handling storing locomotive parts during repairs, the transverse shop affording much more flexible arrangement as well as keeping the shop looking much neater.

Item 9, being a summary of various points for and against the two systems, would then appear as follows:

With Items 1, 2, 6, 7 and 8 equally favorable and Items 3, 4, and 5, in addition to the two items by Mr. Gaines, he considers the summary in favor of the transverse arrangement.

From the above it would surely indicate that modern construction favors transverse shop.

D. E. Barton,
Topeka, Kan. Sante Fe Ry.

TOPIC NO. 2, CONTINUED.

It appears to be the tendency at the present time, particularly on large railway systems, to construct shops with repairing capacity for locomotives of from 30 to 60 or even 90 engines a month, whereas the shops which were constructed prior to 1900, we will say, ordinarily had not more than ten pits and a capacity of from 16 to 25 engines per month as they run and depending, of course, on the number of men employed.

In comparing the output of the average large shop with that of the average ten pit shop, we find that even under the most efficient management that the work deteriorates in the larger shop. There must, of course, be a reason for this, and to my mind the reason is not hard to find. While I favor centralization of work as far as possible, I do not believe that there is the same relative efficiency in the larger shop that is obtainable in the smaller one, and for this reason: Primarily in the smaller shop a foreman will supervise the work and inspect the output of from 20 to 35 men, all of whom are in a necessarily contracted area. It is possible for him to see from nearly any point in his shop every workman in it. This is an advantage, as all would readily admit. In a large shop it is not ordinarily possible for a foreman to exercise this personal supervision, as sometimes the number of men under one foreman will exceed 70 distributed over a wide area. Thus it is not possible for a foreman to come in personal contact with each employe sufficiently to insure maximum efficiency. This is particularly true of the erecting floor, and applies more particularly to shops in which each gang has a certain part of the work to do on each locomotive. Adequate supervision under such circumstances is almost impossible; of course there is apparently an advantage in the large shop in the supervision which is saved by having a fewer number of foremen to supervise the work of the plant. I do not consider this at all an advantage and I believe that a comparison of the work turned out of a modern ten pit shop under good supervision and the work turned out of a modern locomotive shop with a capacity of 45 engines a month, considering the mileage made by the locomotives in both cases between shoppings, and the cost per mile of each locomotive between shoppings, will result in favor of the small shop with its necessarily closer personal supervision and closer inspection.

THE LARGE SHOP CROSS PITS OR LONGITUDINAL PITS—WHICH ARE PREFERABLE?

Personally, I believe in the cross pit, for a variety of reasons. In a shop constructed with cross pits it is possible to hold one or two at one end for the stripping from which the engine (with wheels removed) that may be set to any other pit with a single crane. Thus eliminating the necessity for using two heavy cranes every time an engine has to be moved, as is the case in a shop of any other type of construction. With a cross pit shop your wheels may stand out of doors behind the engine, their driving boxes may be fitted (if this has not already been done on the machinery side), cellars packed, front and back sections of side rods put up and the wheels put in readiness to roll under the engine without using a crane at all and without moving the wheels here, there or elsewhere, which is practically dead labor. This cross pit is certainly an advantage from the fact that all material necessary in repairing and reconstructing an engine has to be moved but twice, from the stripping pit to the point of repairs, and from the point of repairs to the engine. Distances in a shop of this kind are shorter, foremen are closer to their men, therefore the supervision is more intimate and better results can be achieved. I am not at all in favor of a shop with longitudinal pits as I consider it a tremendous handicap. Another criticism of the modern tendency which I would make is inadequate lavatory and toilet facilities. These most necessary features of modern shop construction receive the least attention at the hands of those intrusted with the designing and arranging of the buildings. More time is lost by employes going to and

(Continued on page 354.)

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Value of the Proceedings.

In writing of the early days of the American Railway Master Mechanics' Association attention has been called to the curious disadvantage under which the then newly organized society labored. For a few years after it was started many of the higher officials of the railroads regarded it as an aristocratic form of labor union. The underpaid condition of the master mechanics naturally suggested the suspicion.

On practically the same subject, when speaking at the recent convention of the International Railway General Foremen's Association, Dr. Sinclair said:

"I would like to add a word to what I have already said. It has been suggested that some remarks be made in connection with the standing of the General Foremen's Association before railway officers. When the Master Mechanics' Association was first formed there was a very positive prejudice among many railroad officials that the society had been organized for the purpose of compelling the companies to pay their master mechanics better salaries. That, of course, came from a guilty conscience. The railway officials knew that the master mechanics were underpaid. The General Foremen's Association is somewhat in the same position to-day as the Master Mechanics' Association was in the first two or three years of its existence. There is some doubt as to what the real purpose of the organization is. The sooner you get the proceedings printed and sent out to the various officials so that they can see what you are doing, and what you are aiming at, the better it will be for the whole organization."

This issue of RAILWAY AND LOCOMOTIVE ENGINNERING now contains the concluding papers read at the General Foremen's Association. The first installment appeared in our July issue. While waiting for the proceedings to be printed in the regular form the members of the association should lose no opportunity to let their superior officers know of their aims and objects as shown by the papers presented. These two issues of our paper contain them all.

Pinned Below Water in Wreck.

It has often been said that the life of an active railroad man out on the road is fraught with many dangers, and frequently calls for as much heroism as may be developed on the battlefield. A strong case in point is that of Mr. C. Cowan, a locomotive engineer on the Delaware & Eastern Railroad.

At a place near Arena, Pa., his engine and part of the train was thrown from the track, it is believed purposely, by a spike placed on one of the rails. The engine rolled down an embankment of about fifteen feet high and was partly submerged in the east branch of the Delaware River. Cowan's legs were caught and held by the reverse lever and sector in such a way that it was impossible for him to free himself and he was thus pinned down in the river with the water above his chin.

The fireman, who was unhurt, endeavored to pry the wrecked lever over, but was unable to do so, after which he held up and rested the engineer's head so that his mouth and nose were kept above the water. The rescue work was difficult, as the lever was several feet under water and the men had to work below the surface to loosen the bolts and nuts. The men not being able to stay down long, and the current being swift, the work progressed slowly. Cowan directed operations and at length suggested what turned out to be the most effective way of doing the work. He had several men stand on the trucks and other debris and thrust one of their number head first under the water. Turns were taken and after five hours steady but difficult work the engineer was liberated.

Cowan was not seriously injured. He faced death and endured patiently and bravely with a strong heart, and with an intelligent appreciation of his predicament. His cool judgment in directing the willing and fearless workers around him contributed in no small measure to his rescue. He displayed brave, strong, manly qualities and is alive to-day to tell the tale.

Smooth Filing.

In smooth filing cylindrical work, when it is necessary that truth should be retained, as in the bearings of shaftings, great care must be taken to advance an equal distance along the work at each stroke of the file. The pressure, which should also be equable, is placed on the forward stroke only, but the file should not be removed from the work in drawing back the file. The cutting velocity should not be too high, as the file teeth are rapidly spoiled at high speeds. It may be noted that the less the amount of filing done the better, as it is physically impossible to retain a perfect round surface with much filing. For this reason as smooth a surface as possible should be made by the lathe tools before applying the file. A long stroke of the file is preferable to a short stroke, as the pressure can thereby be made fairly equal and the teeth of the file having time to cool, are not so readily damaged.

It will be found that the file cuts very sharply on rotating work, for the reason that the number of teeth in contact with the metal are very few as compared with filing flat work. If it is desirable to remove a considerable quantity of metal from a cylindrical body it will be found advantageous to hold the file in a diagonal position on the work, occasionally changing to the opposite angle.

Rubbing the face of the file with chalk is good practice, although it somewhat interferes with the cutting quality of the file it has the advantage of preventing the filings from adhering to the file. A fine wire brush, mounted on leather and fastened to a wooden back, is very useful in cleaning the file. It is necessary to rechalk the file after each cleaning. Files that are unfit for use on flat surfaces on account of being hollow may be used to advantage on cylindrical surfaces.

In the case of rotating disks care must be used in selecting files for such work; the necessity for the flat part of the file being slightly convex will become apparent, and it may be noted that in lathe work, generally, the utmost care should be taken in handling the file, as the tendency of the file to catch on corners or collars or other irregularities on the work is very great. Handles should in all such work be attached to the files as the tang of a file in the hand of even the most skilled mechanic in lathe work is an invitation to accident.

Forms of Iron in Commerce.

One of the descriptions of the land of promise given to the Israelites by the sacred writer in the book of Deuteronomy was that it was a good land—"a land whose stones are iron and out of whose hills thou mayest dig brass." The known importance of iron to the whole human race, even at this early date, is thus indicated. Iron to-day is known to us in several different forms, but the origin of its use dates back into the dim and distant past of the race.

Iron is known to us as pig iron, cast iron, steel and wrought iron. A brief but useful description of the various forms of this wonderful metal was recently given to the St. Louis Railway Club by Mr. Henry Koehler. Pig iron, he said, was the product of a blast furnace and it is here brought into the metallic state. A blast furnace is an upright tunnel or shaft. Coke, iron-ore and limestone are charged at the top, a blast of heated air is forced in close to the bottom. The coke besides furnishing heat absorbs the oxygen in the iron ore. Lime is used to flux the impurities in the ore. Even the purest iron ore contains about 72 per cent. of iron and 28 per cent. of oxygen. About 99 per cent. of iron charged into a blast furnace will reduce and about one per cent. will remain in the slag. Manganese will reduce to metal in the proportion of from 50 to 75 per cent., the rest will remain in the slag. It is possible to dissolve about 15 per cent of silicon in the iron. Aluminum cannot be reduced in a blast furnace.

Cast iron is simply pig iron remelted, usually in a cupola. The air blast is cold and enters the cupola higher up than the heated air enters the blast furnace. In the cupola there is very little change produced on the iron; there is, however, some absorption of sulphur from the coke. The making of malleable iron is in a sense analagous to the operation of case hardening. In both processes the surface only is affected. To make castings malleable they are placed in pots and covered with iron ore and exposed to a red heat, the object is to withdraw the carbon from the casting. Case hardening is practically the reverse process. Cast iron, steel or wrought iron, when heated to redness, with air excluded, in presence of some material containing carbon, can be made to absorb it over its entire surface and so acquire hardness.

The definition of the word steel is still somewhat vague. It expresses the idea of iron that is harder than wrought iron and stronger than cast iron. A blacksmith will call an iron steel when he can temper it, and a manufacturer will call iron steel when any substance has been put in it to improve it. The terms "acid" and "basic," as applied to the making of steel, are relative, and their true significance demands some knowledge of chemistry. When the hearth of a regenerative furnace is made of sand is is called an acid furnace. When the hearth is made of manganese or dolomite it is called a basic furnace. Dolomite contains lime and a good deal of manganese.

In the acid process practically no acid elements except carbon and silicon leave the metal. The silicon, on absorbing oxygen from the air, or iron ore from sand. This oxide of silicon or silica as it is called on coming in contact with the oxide of iron or manganese forms part of the slag, the greater part forming on the bottom of the furnace. Carbon, the other acid element, its oxides are gases and leave the slag in this form. Pig iron used in this process is usually low in phosphorus. The basic or open-hearth process is one in which the metal is confined in material that acts chemically on elements having acid properties. In this process there must be enough lime added to combine with all the phosphorus and silica liberated from the pig, other elements of an acid character are taken up by the slag.

The Bessemer process is now confined to acid practice. Air at about 80 lbs. pressure is forced into the bottom of a huge vessel containing molten metal. In passing through it burns the silicon into oxide of silicon; when this is got rid of the air acts on the carbon and burns it out. The carbon flame is blue like that from hard coal. All the manganese is eliminated; its presence prevents an equivalent amount of iron from being consumed. A process resembling the Bessemer is employed in making acid steel. In this process air enters the converter at the side instead of at the bottom. This allows the carbon to absorb its full amount of oxygen at the surface of the metal. In this way the metal becomes much hotter and no carbon flame can be seen at the mouth of the converter. The manganese does not prevent iron from absorbing oxygen.

Many engineers prefer acid steel. This may be due to the priority of the acid process, and perhaps the unreliable results obtained in the early days of basic practice may have caused prejudice. It is, however, safe to say that steel having the same chemical composition and receiving the same heat treatment will be practically the same physically. Basic steel will supplant acid steel in proportion to the increasing scarcity of the ores that are suitable for acid steel.

Spring Hangers.

In machine shop practice there is a tendency to ignore the exact figures set down by the draughtsman. While there may be occasions here and there in the details of locomotive construction where it may be allowable to depart a little from the mechanical engineer's plans, it may safely be said that the drawings are nearly always correct. Perhaps one of the most common and most pernicious practices among machinists is the alterations that are often made on the length of the spring hangers. As may be expected when the engine is lowered upon the wheels and the wedges are in place and the binders attached, it will be found that when the springs are coupled there are slight variations in the distance that the driving boxes are clear of the binders. In many cases the back drivers will be found to approach too nearly to the binders, in some cases actually bearing upon the binders. In any condition it is the best practice to look upon the situation, whatever it may be, as a temporary one. Springs strong enough to suspend a locomotive do not settle to their normal position at once. It is only after considerable vibration induced by movement of the locomotive that they assume a settled position. It should also be borne in mind that the addition of the weight of water has a material effect on the springs not only in sheer vertical weight, but generally by slightly lowering the back of the locomotive.

The practice of lengthening or shortening the spring hangers to suit the apparent immediate condition has several disadvantages. It creates confusion in the material of that class of locomotive to which they may belong, and as in all classes the quality of interchangeability is a valuable one, it will be found that the changes in the length of the spring hangers rarely meet the requirements of the situation for any length of time. It need not be wondered at if another change is necessary in a short time when the springs find their true limit of flexibility and settle into position.

The best practice is to have the slots in the spring hangers sufficiently long to admit of different sizes of keys. These can be changed speedily and if the hangers should require shortening, clips of simple construction may be added under the keys. In the event of the hangers having their bearing under the frame the admission of liners can be readily made to suit the required position.

It should be established as a rule that the dimensions of the hangers should not be changed under any condition. It is a costly and doubtful remedy, and in the end is calculated to add to the troubles of a locomotive instead of mitigating them.

A more important defect in spring hangers is their tendency to cut into the frames of the locomotives. This evil can be considerably guarded against by a careful adjustment of the springs on the saddles. The clearance of the spring hangers on the sides of the frames should be carefully noted and equally divided and in the case of a tendency to bear upon one side of the frame the evil can readily be rectified by the admission of a thin liner under one of the legs of the saddle.

In some locomotives it will be noted that there is a low corner where the driv-

ing box is further removed from the binder than on any of the others. This is a sure sign of an organic defect in the setting of the frames and being past remedy is one of those evils which must be endured and made the best of. A defect of this kind may be compromised by the adjustment of the spring hangers so that the variation, whatever it may be, may be divided between the two sides of the locomotive.

Removal of Facing Points.

The possibility of an accident from an "open switch" has been removed at 1,078 different points on the Pennsylvania Lines east of Pittsburgh and Erie during the past four years, according to a compilation which has just been completed by the Pennsylvania management, following the adoption by the United States Senate of a resolution directing the Interstate Commerce Commission to investigate and report on the use of facing-point switches on railroads in the United States.

From January 1st, 1904, to January 1st, 1908, on the Pennsylvania Railroad, 743 hand operated facing-point switches were removed and in place of all these 125 trailing switches were substituted. One hundred and ninety-eight facing-point switches at interlocking plants were removed entirely and 12 trailing switches substituted. In the work of eliminating facing-point switches, especial attention was directed toward abolishing those not protected by interlocking signals.

Owing to the growth of traffic in the four years previous to January 1st, 1908, and the constantly increasing number of industrial plants requiring switching connections, as well as the consequent additions to the second, third and fourth track mileage, it was necessary to install many switch connections and crossings which were not needed prior to the year 1904. This is evident from the figures showing that the total mileage of the running tracks increased in the four years from 7,599 to 8,114, while 409 siding connections were established in that time. With this large increase in both siding connections and additional switch crossings from one track to another, only 1,094 facing-point switches were installed during the four years, and all of these were safely interlocked.

The Critical Point.

Speaking at a recent meeting of the St. Louis Railway Club, Mr. H. Koehler, chief chemist of the Scullin-Gallagher Iron and Steel Co., referred to what is known as the critical point in the temperature of iron and steel. He said:

"When pure iron is allowed to cool from say 1,200 degs. C. at a rate of 2 degs. C. per second, to a temperature of 858 degs. C., there is a sudden arrest, and it will require 26 seconds to cool 13 degs. C.; this point is known as the point of recalescense. In steel containing a moderate proportion of carbon there are two such breaks, with steel containing 1.25 per cent. of carbon there is only one arrest; it begins at 700 degs. C., and has a duration of 76 seconds. When a distorted axle is heated to redness it would appear that at red heat it would take less strain to straighten, but in spite of this, when it passes through the critical point it will straighten with less force than at any other degree of heat. Critical point is not peculiar to iron or steel; almost every substance has a critical point. Take water for instance, when steam is heated to 358 degs. Centigrade, no amount of pressure can keep it liquid; this is known as the critical temperature. Its recalescense is at its freezing point; it is a well-known fact that water has the same temperature as ice immediately after the ice has melted. When steel containing carbon is heated above its critical point, the carbon is dissolved; if it is rapidly cooled to allow no time for re-crystallization the steel will be much harder than when the cooling process was slow."

Book Notices

Railway Organization and Working. Edited by Ernest Ritson Dewsnup. Published by the University of Chicago Press. 500 pages, cloth. Price $2.00.

This work is a compilation of a series of lectures delivered before the railway classes of the University of Chicago. The lectures were originally undertaken, in association with a number of railways, with a view to aid in the training of railway employees, with the object of increasing their professional efficiency. The demand for printed copies of the separate lectures has been very great, and the editor and publishers have acted wisely in presenting the collected discussions in one volume. In a certain sense the book occupies a unique place. It is the collected thoughts of twenty-five railway experts of the highest reputation on subjects of their own choosing, and which, to say the least, their words are worth listening to.

A careful study of this volume will give the student of railway economics a clear appreciation of the vast field of human endeavor under his consideration. It shows very clearly how important and multiplex the organization and working of the modern railway system has become, and how necessary it is that men properly equipped for the work should be found to carry on the work which has been so far nobly advanced. On the subject of railway education there is an admirable essay from the pen of the editor, which is worthy of the earnest attention of young railway men. It is indisputable that the more efficient training of railway men receive, the greater good they will be able to confer upon the community with whose interests their business is indissolubly connected. The book deserves and undoubtedly will receive much popular favor. While it does not cover the entire field of railroad operation, it throws a flood of thought on many departments that cannot fail to be of lasting benefit to all interested in the complex problem of railway organization and working.

Air Brake Catecnism, by Robert H. Blackall. Published by the Norman W. Henley Company, New York, 1908. Twenty-third edition, revised and enlarged. Price $2.00.

This is what may fairly be called a thoroughly up-to-date book. It is a complete study of the equipment manufactured by the Westinghouse Air Brake Company, including the Schedule ET Locomotive Brake Equipment; the K (Quick-Service) Triple Valve for Freight Service; and the Cross-Compound Pump. The operation of all parts of the apparatus is explained in detail, and a practical way of finding their peculiarities and defects, with a proper remedy is given. This book has been endorsed and used by air brake instructors and examiners on nearly every railroad in the United States and Canada.

It contains nearly 2,000 questions with their answers, giving a detailed description of all the old standard and improved equipment and also all the necessary information to enable a railroad man to pass a thoroughly satisfactory examination on the subject of air brakes. The book is fully illustrated by plates, half-tones and line cuts. It is well and clearly printed, and has 380 pages. Among the new apparatus which is dealt with in this book may be mentioned Nos. 5 and 6 ET Equipment; H-5 Brake Valve. SF (independent) Brake Valve. SF Pump Governor. Distributing Valve. B-4 Feed Valve. B-3 Reducing Valve and the Safety Valve.

Construction and Maintenance of Railway Roadbed and Track, by Frederic J. Prior. Published by Frederick J. Drake & Co., Chicago, 1908. Price, $2.00.

This book has been arranged and compiled with a full description of railway surveys and construction. It is very fully illustrated and is of convenient size. Mr. Prior modestly assigns to himself the role of compiler and editor of this work rather than that of author. Credit is given in the text where it is due, and thus the practical nature of the methods explained is at once apparent. The book covers the whole field indicated by its title. It takes in railway construction, construction accounts, land, track, structures, supplies and equipment for field parties, maintenance of way, testing steel, rail joints, laying track, easy rules, bridges and buildings, curve and embankment tables, trestles, tables of ordinates to vertical curves, the six-chord spiral, engineering tables, etc., etc.

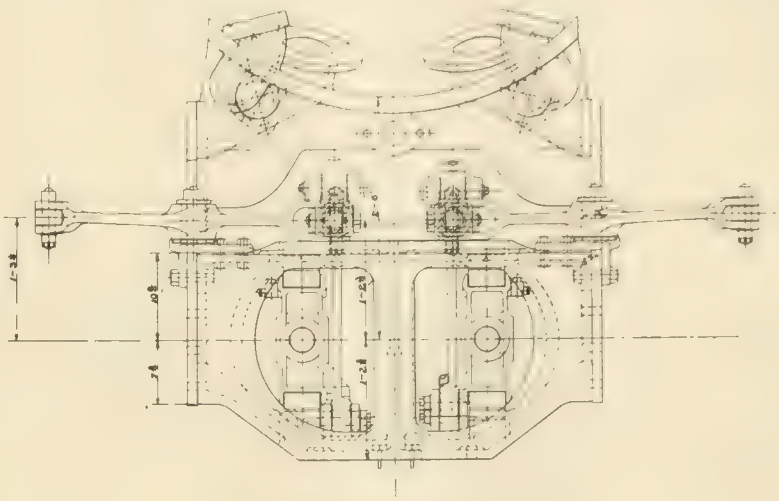
Four Cylinder Simple Engine

Walschaerts Gear, One Eccentric Drives Two Valves

High on the roll of eminent British locomotive engineers stands the name of G. J. Churchward, who, after rendering able assistance to the late Mr. William Dean, in 1902 succeeded that gentleman as Chief Mechanical Engineer to the Great Western Railway Company, and since that date he has amply justified the confidence with which his appointment was hailed. He has introduced into British practice the coned or taper boiler without dome or perforated pipe for the collection of the steam; the 225 lbs. steam pressure; the design of compound Atlantic locomotives associated with the names of M. M. du Bousquet and De Glehn; the 30-in. piston stroke, and the superheater. He has utilized the Belpaire firebox and the principle of six-coupled wheels for express work. He has revived the ordinary domeless boiler and the outside crank.

We here illustrate one of his locomotive designs for express passenger work. This is a ten-wheeled locomotive of the 4-6-0 type, with four high-pressure cylinders, and it represents the logical outcome of Mr. Churchward's experiments and experience. The present example of Great Western practice is not novel in respect of the use of four high-pressure cylinders, for engines of this type have been for several years at work on the London and Southwestern, the Great Northern and the Glasgow and Southwestern. It is in the combination of the six-coupled wheels with the four high-pressure cylinders that Mr. Churchward's type is unique.

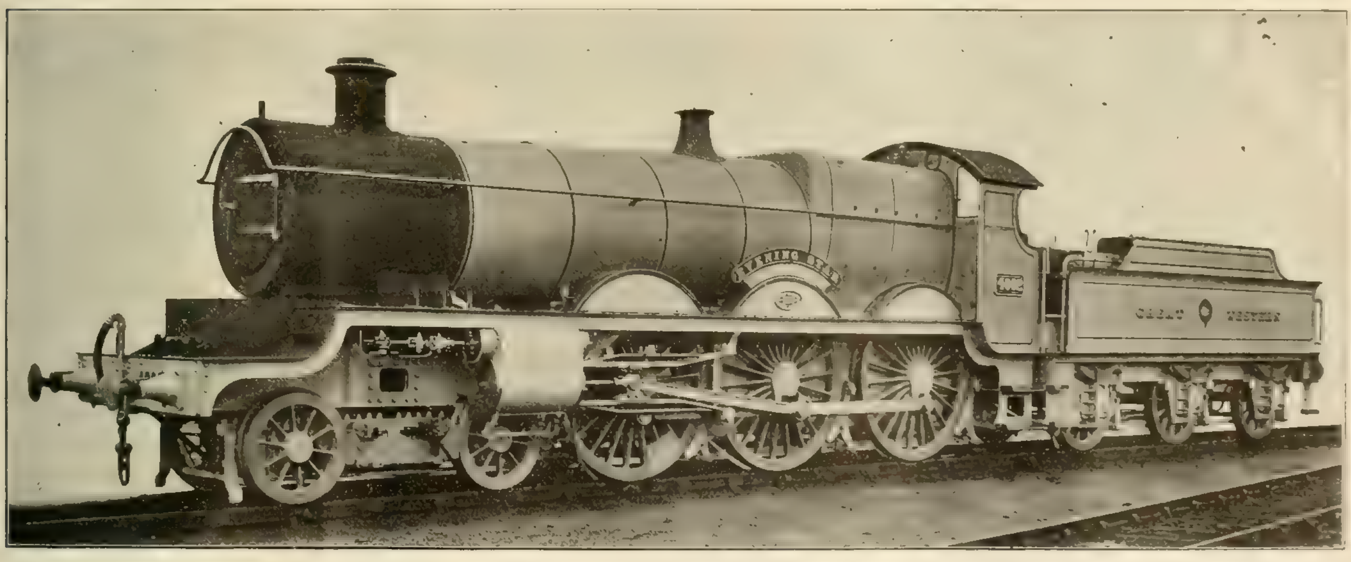
During the summer months traffic on the G. W. R. increased so that loads of 350 to 450 tons behind the tender had to be hauled at speeds of 57.7 to 59.1 miles per hour for 3-hour non-stop runs, with numerous slow-downs and severe gradients to be climbed, and the necessary rapid acceleration when starting and prompt recovery after checks, lead to the 4-6-0 design. The Atlantics, although powerful enough in other respects, had been found deficient in adhesion with heavy trains. The tractive effort of both classes is practically the same—26,560 lbs., but with the four-coupled wheels the adhesive weight is only 39½ tons as against 58½ tons for 4-6-0 engines with same boiler, etc.



SECTION BETWEEN FRAMES.

The engines of which we write are ten 4-6-0 machines of what they call on the Great Western the "Dog-Star" class, as the first of the series bore that name. In these ten engines the inside pair of cylinders are placed forward of the bogie center line and drive on to the leading cranked axle; the outside cylinders are placed at the back of the bogie center line and drive on to the centre coupled wheels. The cranks are set on all quarters, the outside cylinder crank being at 180 deg. to that of the adjacent inside cylinder.

The prevailing practice in the use of Walschaerts valve gear in this country is to put it on the outside of the rods. The fact that the gear is readily adaptable to this form of design is one



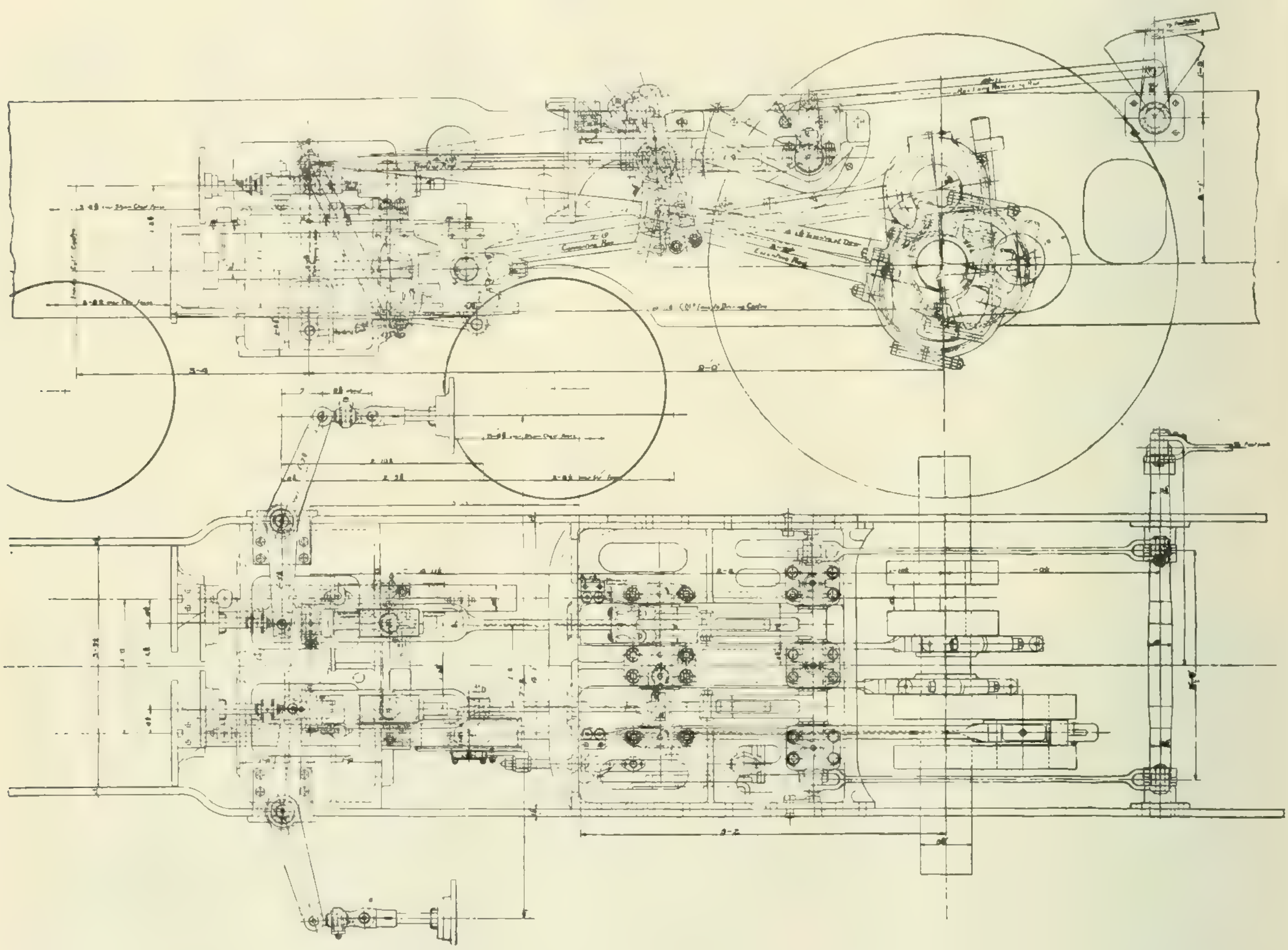
FOUR-CYLINDER SIMPLE 4-6-0 ON THE GREAT WESTERN OF ENGLAND.

of the reasons for its popularity in America. With us it has the merit of accessibility. Through the courtesy of Mr. G. J. Churchward, chief superintendent of the locomotive, carriage and wagon department of the Great Western Railway of England, we are able to show a design of Walschaerts valve gear actuated by eccentrics on the main driving axle of this 4-6-0 express engine, and so arranged as to have horizontal rocker arms to transmit motion to a pair of piston valves placed in the usual position.

that two eccentrics operate four valves, and the whole design is compact, the valve rods passing through the leading ends of the valve chests.

The boiler has a barrel 14 ft. 10 ins. long, coned from the smoke-box, the extremes of outside diameter being 4 ft. 10¾ ins. and 5 ft. 6 ins. The Belpaire firebox is of the following dimensions: Outside, 9 ft. by 5 ft. 9 ins. by 4 ft. Inside, 8 ft. 2 7/16 ins. by 4 ft. 9 ins. by 3 ft. 2⅝ ins. Height, 6 ft. 6⅜ ins. and 5 ft. ⅜ in., having a firegrate area of 27.07 sq. ft., and supply-

the Great Western has 28, have been doing magnificent work. One of them has recently hauled 15 8-wheel coaches, weighing 410 tons full, from London to Bath (106⅞ miles) in 105 minutes, and another has taken 22 8-wheel vehicles, total weight 530 tons, from Swindon to Reading (41¼ miles) in 50 minutes, start to stop. The "Evening Star," like the others in the "Dog Star" class is a fine example of simple 4-cylinder engines, and the whole design is at least original and preserves the exceedingly neat appearance of the



WALSCHAERTS VALVE GEAR ON G. W. R. ENGINE "EVENING STAR."

The "Evening Star" is a simple engine. The Walschaerts valve gear actuates the valves, governing steam admission to the cylinders inside the frames, and from the little crosshead on the valve rod the inside end of the horizontal rocker is attached. The rocker has a horizontal offset of 7 ins. This arrangement of the horizontal rocker compensates for the position of the eccentrics with regard to the crank pins. The eccentrics are set with reference to the inside cranks and by the use of the horizontal rockers the eccentrics are made to do duty in driving all the valves. It thus appears

ing 154,26 sq. ft. of heating surface, which, with the 1988.65 sq. ft. given by the 250 2-inch tubes, 15 ft 2 5/16 ins. long, makes the total heating surface 2142.91 sq ft. The boiler pressure is 225 lbs. per sq. in., and each of the cylinders is 14¼ ins. in diameter by 26 ins. stroke.

Steam ports are 25 ins. by 1¼ ins., and exhaust 25 ins. by 3 ins. The bogie wheels have a diameter of 3 ft. 2 ins., and the driving wheels 6 ft. 8½ ins. The total weight of the engine is 75 tons 12 cwt. and of the tender 40 tons, each in working order.

These 4-6-0 locomotives, of which

engines which is in conformity with English practice.

The belief that there is one road to knowledge is fundamentally wrong. There are as many ways of getting ideas as there are individuals. No one has a monopoly on the manner in which children arrive at the number concept, though some have tried to patent the process. Mental flexibility is essential to intellectual growth, and the ability to adapt oneself to the innumerable ways in which mind matures, marks the born teacher.—*Mind in the Making,* by *E. J. Swift.*

Applied Science Department

Elements of Physical Science.

XVI. MAGNETISM.

Magnets are of two kinds, Natural and Artificial. The natural magnet is an ore of iron, known as loadstone, and has the quality of drawing other metallic bodies to itself. Some other metals and compounds possess the same quality in a lesser degree. Among these nickel, cobalt, and brass when hammered, all have some magnetic quality. A peculiarity of the natural magnet is the fact that its attractive power is not equally distributed over the entire body or mass of the magnet, but is strongest at the extreme ends. This is readily shown by rolling a piece of lodestone in iron filings, when it will be seen that the filings will cluster about the ends while the middle is left bare. These points where the greatest attraction is manifested are called the poles of the magnet.

Magnets will sustain many times their own weight, and their attractive power may be increased by applying to their opposite polar surfaces strips of soft iron. These strips may be used to bring the two polar extremities nearer to each other, as the ends of the strips then become the two Poles. The effect is still further increased by uniting these poles with a cross piece of soft iron.

When a natural magnet is brought in contact with a piece of iron or steel, its peculiar attractive qualities are caught by these metals and they in turn become magnets and attract filings or other light metallic substances. When soft iron is removed from the magnet the iron loses its attractive properties, but pieces of steel brought in contact with the magnet retain them permanently, while the original magnet from which the steel obtained its new quality does not suffer any diminution of attractive force. Such pieces of steel so magnetized are called artificial magnets. When several pieces of bar steel so magnetized are riveted together the power is greatly increased and they are more efficient and regular in their action than natural magnets. A horseshoe magnet, so called from having the two poles brought near to each other, something like the ends of the shoe and made of steel bars, and weighing one pound, will suspend a weight of over twenty pounds.

A singular attribute exists in all magnets, whether natural or artificial, in the fact that their attractive power may be increased by adding a little weight each day to that which it already supports. Heat diminishes the power of all magnets, and if the metals composing the magnets are heated to a red heat their power is entirely destroyed even after the magnet is cooled.

Magnetic force corresponds exactly with the law of gravitation, that is, the power decreases according to the square of the distance.

A small rod of magnetized steel left free to move by being balanced on its centre always points north and south or nearly so. Not only so, but on being disturbed the same points return to their positions. This property is called magnetic polarity, and while subject to magnetic variations, the causes of which have not been fully discovered, the polarity of the magnetic needle, as applied in the mariner's compass, enables us to determine a given direction at any place on the earth's surface.

THEORY OF MAGNETISM.

Magnetism, like electricity, is now generally regarded as a mode of force operating on matter, the particles of which it polarizes or arranges in a definite direction. A magnet is said to be a collection of metallic molecules polarized, all of the positive poles being turned in the same direction, while the negatives are arranged in the other direction. The opposite polarities are shown in force at the extremities of the magnetized body, but nullify each other at the centre of the magnet. The loadstone is by natural forces constantly in a polarized condition. The earth in its entirety may be considered as a vast magnet. At the centre or equator of the earth there is no perceptible magnetic force. The seats of magnetic energy appear and increase in intensity toward the polar extremities.

It may be noted that there is an intimate connection between electricity and magnetism and that their forces, as exhibited in natural phenomena, are merely the same, only acting under different circumstances. Steel bars may be magnetized with an electric current more efficiently than in any other way. Various attempts have been made to utilize magnetic force. Boats and even locomotives have been constructed, but except in short distances they have not successfully competed against steam.

The electro-magnetic telegraph has been among the crowning practical triumphs of human ingenuity. Its principle of action consists of the fact that an electro-magnet may be alternately endowed with and deprived of the property of attracting iron by connecting and disconnecting it with a galvanic battery. The battery may be at a remote distance from the magnet. If the magnet and battery are connected by wire the electric current will produce the same effect.

The circuit may be completed or broken at pleasure. A simple mechanism is used in long distance lines to make and break the contact for a local circuit which operates what is called a sounder. Years ago, when the electric telegraph was comparatively new, a recording instrument was used whereby a ribbon of white paper was drawn steadily along under the point or stylus of the recording machine. A series of dots and dashes were thus indented in the paper and this was used with the Morse code. In time operators learned to distinguish the various sounds made by the formation of each letter and figure and the recording mechanism gave place to the metallic click of the powerful telegraph sounder.

The Alphabet-Dial Telegraph.

The earliest practical form of electric telegraph was that invented by Sir Charles Wheatstone in 1840. It was called the alphabet-dial telegraph, and was a very ingenious though simple piece of mechanism. The receiving instrument consisted of a white disc upon which, near the circumference, the twenty-six letters of the alphabet were painted in black, very much as the figures are on the faces of our clocks to-day.

The dial had one hand and behind the disc were two electro-magnets with long arms which, when the magnets became active, were made alternately to strike against suitable stops. At each movement of an arm one tooth of an escapement wheel was advanced and the dial-hand moved from one letter to the next.

The sending instrument was somewhat similar and was called the commutator, but consisted of a wheel, upon which were a number of pieces of brass and ivory arranged alternately. Pressing against the circumference of this wheel, one on each side, were two spring connections which were in circuit with a battery. These connection ends of the springs made contact and were insulated alternately as the wheel was turned in the proper direction by the operator. As the spring ends made contact with the brass knobs on the circumference of the wheel, a current of electricity flowed and this energized the magnets of the receiving instrument, one of the arms moved and the ratchet wheel carrying the dial-hand

moved from one letter to the next. The wheel of the sending instrument was provided with letters on a disc so that the sending operator could see when the desired letter was reached.

In sending a message with the word "Railway" in it, the operator turned his wheel slowly until the letter R was at the neutral point and as by this means eighteen electric impulses had traversed the wire and eighteen teeth of the ratchet wheel had been taken up, the dial-hand stood at R, and a pause was made to enable the receiver to record the letter. The sender then moved the wheel to the starting point and the receiving instrument hand traversed over the remaining letters and came to zero on the dial. The next letter, A., was made by one motion of the wheel followed by a pause. Then eight more teeth were taken up and a pause was made at I. Three more impulses were sent and L was reached, and a recording pause made. Then on to W. and the hand was again brought to the zero point and the letter A was again struck, and to complete the word the wheel was moved to Y and the receiving dial clicked round to the twenty-fifth letter.

The method of sending messages was necessarily slow, as unless the letters of a word followed each other in their natural sequence the whole alphabet had to be gone over. A pause indicating the required letter. The instrument was a success and was fairly reliable, but the possibility of missing a tooth led Wheatstone to improve on this machine by inventing a type printing mechanism which was more accurate and simplified the work of the receiving operator.

When one speaks of this machine as slow in action and of wanting somewhat in accuracy, it is necessary to remember that we are perhaps unconsciously comparing a primitive machine with the well-nigh perfect instruments of to-day. Wheatstone's telegraph was a truly marvelous affair, as before his time there had been no such thing, and with nothing to guide him but his genius he strode forward and blazed a path for others to follow in the hitherto unexplored field of applied science.

Celebrated Engineers.

X.—Richard Trevethick.

About the time that Watt's steam engine was superseding Newcomer's atmospheric pumping machine, a young lad named Richard Trevethick, was growing up among the Cornish mines. He came of a family remarkable for their physical strength and at an early age the lad excelled in throwing weights and wrestling. His father was a mine manager, and although young Trevethick had little more than the rudiments of an education he early exhibited a rare inventive faculty in mechanics. His first invention of importance was what is known as the pole plunger pump, which was immediately recognized as the best pump in deep mining. The success attending the rapid introduction of Watt's engine induced many engineers to endeavor to adapt it to other purposes than those which had been so successfully established by Watt. Not only was Trevethick successful in extending the uses to which the steam engine may be put, but he gave something of his own Titanic strength to Watt's engine. He was the first to abandon the low pressure, condensing engine, and in 1798, at the age of twenty-seven, he produced the first high pressure non-condensing steam engine. This immediately became a successful rival of Watt's slow moving, low pressure, condensing engine. In fact it looked as if Trevethick had breathed new life into the steam engine. The increased strength and velocity of the wonderful machine amazed the engineering world and Trevethick at once became the rival of Watt.

Some years previous to this he had met with Murdoch, the able superintendent of the works where Watt's engines were constructed. There were many points of resemblance between Trevethick and Murdoch. Both were of colossal stature and Herculean strength. Both were clever inventors and both have left their mark on the steam engine. Of the two, Trevethick was the more original. With less skill and perseverance than Murdoch he had a wider mechanical vision. His work was not the work of slow, laborious, painstaking endeavor. It came in master strokes, and impatient of results his mercurial mind, instead of pushing his inventions to popular success and the advancement of his own fortune, seemed to run into new channels.

He produced the first locomotive engine, a model of which is in the South Kensington Museum, and on Christmas eve, 1801, his common road locomotive carried the first load of passengers ever conveyed by steam. For several years his locomotive was run on the streets of London, but the cost was too great. Trevethick next produced a steam locomotive for tramways which ran with facility up and down inclines of between two and three per cent. In 1808 he constructed a circular railway in London on which the public were carried at a speed of fifteen miles an hour. Meanwhile he applied his high pressure engine to other work, and the steam drill for rock boring, as well as the stone breaking and crushing machine are both of his inventing, and both were at once completely successful.

In 1806 he invented the steam dredging machine and secured an extensive contract from the Government to lift ballast from the bottom of the River Thames. He also engaged in the first effort at tunnelling under the Thames. After the battle of Trafalgar his active mind ran toward ship construction and he was the first to submit plans for the construction of iron ships. In rapid succession he produced steam ploughs, threshing machines and other agricultural implements. In 1814 he secured an extensive contract for the construction of mining machinery for the Peruvian government. He also engaged in engineering work in Costa Rica.

It is indeed surprising that he found time to engage in so many enterprises and also to produce so much in mechanism that was really new. In addition to what has been already alluded to, he produced the first cylindrical boiler which soon became universal in use. In one patent he minutely described the modern screw propeller. In another he projected the heating of apartments by steam now common in America. In steam engine improvements in addition to the really important advance made by the use of steam at a high pressure he experimented with superheated steam.

It is to be regretted that in spite of his industry and remarkable ability he lacked that degree of patience which is essential to success in any department of human endeavor. He moved from place to place and seemed always on the verge of making a great fortune out of his great projects. His Peruvian adventure was very promising when one of those periodical revolutions occurred and he barely escaped with his life. His repeated appeals to the British government met with little or no encouragement. Beginning with high hopes and bright prospects, a giant among men, a prince among engineers, possessed of many eminent qualities, it is sad to think that his life darkened toward its close. Even during his lifetime others were reaping the fruit of his inventions. He died poor and friendless in 1833 at the age of sixty-two. His grave is unknown.

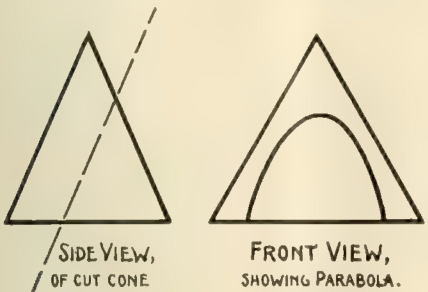
Such in brief is the life's history of Richard Trevethick, who, because of his masterly adaptation of the steam engine to locomotion, may justly be called the inventor of the modern locomotive.

Beavers' Hint to Dam Builders.

Human science owes many a debt, especially on the practical side, to the instinct of the lower animals. One of these obligations is cited by an eminent authority. Engineers frequently build dams straight across streams, the object being, in some cases, to save expense by sparing material. But the beaver arches his dam against the current, and experience has shown that this form of dam is best to resist floods and the impact of floating ice. Acting upon the knowledge which is instinctive with the beaver, and which human calculation approves, the Great Bear Valley Dam, in California, and some other dams in that State have been constructed and so made that their stability depends upon the resistance which their arched form presents.

Derivation of the Semaphore Lens.

Every railroad man knows what a headlight reflector is like, and every railroad man is familiar with a semaphore lens. The reflector and the lens do not look very much alike but they are closely related, nevertheless. They have one thing very clearly in common, and yet they are themselves dissimilar. The reflector, as its name implies, reflects light and the lens transmits and refracts light. The reflector is opaque while the lens is transparent.



DERIVATION OF THE PARABOLA.

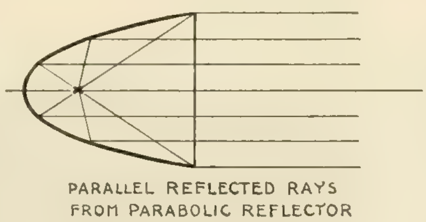
The thing they have in common is the property derived from that very wonderful curve, the parabola. A parabola is the curve made when a cone is cut by a plane parallel to one of its edges. The shadow of a cone on a wall is a triangle or like the outline of the letter A. Now if the cone represented by A was sawed down along a line parallel to one of the long legs of the letter, the outline would be a parabolic curve, and this curve revolved about its axis gives us the familiar form of the headlight reflector. The curve is one of the family of conic sections, so called from the fact that each is derived by the cutting of the cone.

The property of a reflector made in this form is that when a light is placed at one particular point on the axis of the reflector, light radiating from the illuminating point in all directions and striking the reflector, leaves it in lines parallel to the axis, and make one powerful non-divergent beam of light. The point where the light must be placed to produce this result is called the focus of the curve or of the reflector.

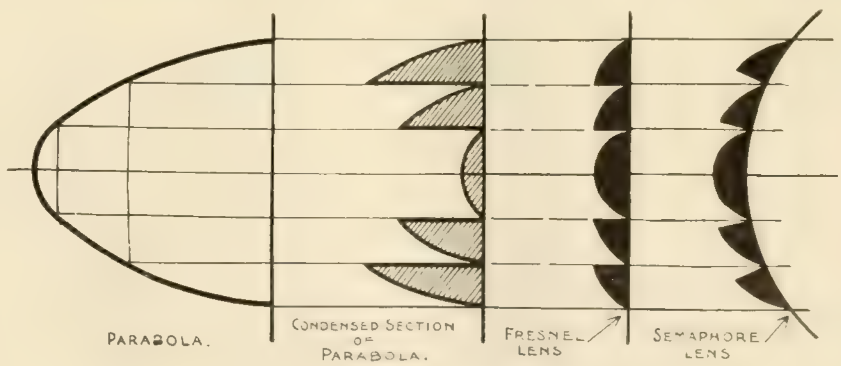
The semaphore lens does the same thing in another way. It gives out a powerful beam of light, the rays of which are all parallel. This is done by refraction or the bending of the ray of light as it passes through the glass, so that no matter at what angle a ray of light strikes upon the inner surface of the lens it will so pass through the glass that it will leave the outer surface in a line parallel to the axis of the lens.

The principle which is made use of in the semaphore lens was invented by a celebrated French scientist named Fresnel, who, in 1822, applied it to a system of lighthouse illumination. The Fresnel lens, as it is called, consists of a disc of glass, flat on the inside and curved on the outer side. This central area is, of course, circular, and the exterior surface is really a parabolic curve. A light placed in the focus of this curve is refracted so that it leaves the lens in parallel lines. Surrounding this central circle are a number of concentric rings which are really prisms, having flat inside faces and with their exteriors so curved as to produce the same effect. The overhang of each prism is flat, and being parallel to the axis of the lens does not receive or transmit any light.

The semaphore lens is practically a Fresnel lens. It is, if one may so say, a parabola shut up like a concertina for the sake of the economy of space. It is very much as if one should saw a headlight reflector up into a number of sections parallel to the glass in the front of the case, and should then push them all together up against the casing glass. If the now "telescoped" parabolic headlight reflector could be transformed into glass by the touch of some magician's wand, we would have for all practical purposes a Fresnel lens similar to that used in our semaphore and signal lamps. Strictly speaking, the prisms are not parabolic curves. To make them to this curve would require considerable space. The curve of the prisms is so calculated that they may all be kept about the same size and a light placed in the focus of these concentric rings gives off rays which are parallel after passing through the lens. In this way the practical result of using a parabolic lens is gained, and the semaphore lens is perhaps more accurately described as a modified Fresnal lens. The headlight reflector and the semaphore lens are thus found to be first cousins on their mother's side, and she is a Parabola and belongs to that honorable old family of curves, the Conics.



ACTION OF THE PARABOLA.



EVOLUTION OF THE SEMAPHORE LENS.

Questions Answered

AIR PUMP LUBRICATION.

53 A. H., Wheeling, W. Va., asks: What if any, is the objection to putting oil supply pipe to air pump directly into steam chamber of 9½ and 11-in pumps as practiced by Mr. J. R. Alexander of the P. R. R.? Is it absolutely necessary that the governor receive part of the oil that goes to the pump?—A. Leaks from the air pump, steam pipe, from the governor drain or waste pipe, or from the top head gasket, rob the pump of part of its oil supply when the oil pipe connection is made in the usual manner, and if the pump is supplied in the manner you mention, those leaks cannot prevent the pump from getting the oil fed to it. It is not necessary that the governor receive any oil and the connection to the top head is the inconvenience of drilling and tapping the top head and changing the pipe, and care should be taken to arrange the pipe so no water can accumulate and freeze.

POSITION OF DIAPHRAGM.

54 A. H., Wheeling, W. Va., writes: Please give rule for finding the area of opening between draft plate and bottom of front end. Should this equal total area of opening in flues, as a basis for arriving at a standard height for diaphragm with any given class of engine as a starting point to work from?—A. There is no set rule for the drafting of an engine. No two engines are exactly alike in this respect and the kind of coal burned makes a good deal of difference. Your idea about the opening below the diaphragm being equal to the combined area of the flues is not recognized as the rule. All the smoke box gases and the exhaust steam eventually go out of the smokestack which is much smaller than the combined area of the flues. They all pass out with great velocity, and the diaphragm is made adjustable so that as the opening is enlarged or contracted the speed of movement of the smoke box gases will be slow or fast as circumstances

may demand. The only way is to set the diaphragm where you think it is likely to produce the best results, watch the effect and alter accordingly. It is finally always a case of cut and try.

SIZE OF STORAGE RESERVOIR.

55 G. I. D., Panama writes: Please inform me what size reservoir it would be necessary to use for a 9½-in. air pump to supply compressed air for small shop for use of air motors and air tools in general?—A. This question is more concerned with supply than with storage. If the amount of air required to operate the tools in your shop is not in excess of the capacity of the pump, a locomotive reservoir should answer the purpose, of the size 22½ x 60 ins. This contains 12½ cu. ft. of air and weighs about 390 lbs. If, however, the supply is insufficient, the larger the reservoir, the more air the pump can compress and store during the time the tools are not in use. This is only a very general answer to your question, as it is impossible to get closer to your requirements, unless we knew how much air you require, or what tools you operate by air.

SIZE OF ORIFICE W. A. B. PUMP.

56 D. O. B., Morton Park, Ill., writes: Please let me know the size of the leakage orifice that a No. 8 and No. 9. Westinghouse pump should keep up a pressure of 90 lbs. against, with 100 lbs. of steam.—A. The steam and air pressures you mention are too close for an efficiency test, the 9½-in. air pump will scarcely compress more than 90 lbs. of air with 100 lbs. steam if the air cylinder has ever been rebored or if there is a slight leakage past the packing rings or valves in the air cylinder. With 160 lbs. of steam the 9½-in. pump should maintain the pressure at 90 lbs. with an orifice of 3/32 of an inch. You may have in mind a test for repaired pumps on shop rack; if you are in doubt about the condition of the air cylinder of a repaired pump we would suggest the use of a vacuum gauge, which should show about 26 ins. if cylinder is in good condition. As the capacity of the 8-in. air pump is now insufficient for either road or yard work, you probably refer to the Westinghouse 8½-inch cross compound pump; this pump is designed to be run with 160 lbs. or more steam pressure and will easily maintain 90 lbs. pressure with a ¼-inch opening. With 200 lbs. steam pressure this pump has compressed air from 118 to 120 lbs. in 2 minutes with a 1 7/64 opening.

ALTERATION OF VALVE TRAVEL.

57 A. L., Fort Wayne, Ind., writes: If an engine is designed for six inch valve travel, and is reduced to five by means of a change in the eccentric, what effect will it have, if any, on steam distribution at full gear and close, or six inch cut-off? Will it change the lead at either point.—A. In reducing the size of an eccentric the effect on the travel of the valve is the same as if the eccentric had been of the full size and the reverse lever drawn some distance away from the extreme front or back notch. The exact position at which the valve will travel one inch less than the full travel can very readily be found by experimenting with the lever. The lead will in either case be slightly increased. It is poor practice, however, as the cut-off will occur sooner and the full force of which the engine is capable can never be again put in effect.

ONE OF THE CHICAGO & ALTON FLYERS WITH THE SHOP STAFF.

"Linked at Last."

Our illustration of the Chicago & Alton passenger 4-6-2 engine is a striking one as it shows the size of the machine when compared with a group of men. There are in the picture about sixty happy looking men. Clean-limbed fellows, as Rudyard Kipling might call them, and in a characteristic way the Alton has these men "linked at last," as well as Chicago, St. Louis and Kansas City.

The flyer has 22 x 28 in cylinders, a boiler pressure of 200 lbs. and 80-in. drivers. Its tractive effort is about 28,798 lbs., and it weighs in working order 221,300 lbs. The tender weighs 166,600 lbs., making a total of 287,900 lbs. Compared to this, the men look very insignificant, as they probably weigh all together about 9,000 lbs., but the men are not so insignificant after all, because as these men are like those out in the Soudan that Kipling speaks of when he says, "These make come and go great boats or engines upon the rail, but always the English watch near by to prop them when they fail," and if it wasn't for the corps of intelligent and capable men who do the "propping," the engines would not be kept going at all. It's "the only way," as they say on the Alton.

The heating surface inside the boiler is 3,436 sq. ft., and that is nearly equal to the surface of a board walk 2 ft. 7¼ ins. wide and a quarter of a mile long, so you can see what sort of a conflagration the fireman has to attend to keep her hot. The over-all length of the engine and tender is 75 ft. 6 ins., but the men's overalls don't measure anything like that. The engine is a fine specimen, and so is each one in the group. Good luck to them all!

The Alton has recently cut out some good work for these engines to do, for there was recently a thirteen-hour express train put on between Kansas City and Chicago. The train connects with the Twentieth Century Limited of the New York Central and the New York express of the Pennsylvania, and the Alton's passengers from Kansas City now reach New York in 31 hours.

Air Brake Department

Broken Air Pipes.

After being in service for a considerable length of time the large, powerful locomotives of to-day have a tendency to break air pipes. If the locomotive is kept in good condition, and if the different parts of the air brake apparatus are securely fastened to the boiler and frame, and if the air pipes have been properly fitted, very little trouble will be experienced from leaky and broken air pipes.

Very often the reservoirs and cylinders are shaken loose and an air pipe broken off, and frequently an engine failure is the result. A broken air pipe does not always result in an engine failure, sometimes the break can be overcome and a failure avoided by stopping the flow of air from the broken pipe and connecting the volumes separated by the break, in some other manner.

It will be the object of this article to show, by means of the piping diagram, how a number of different breaks in air pipes on a locomotive equipped with the New York Air Brake Co's. B-2 HS equipment can be handled to prevent an engine failure and the train brought to the terminal with the brake pipe charged ready for application.

BROKEN RESERVOIR PIPE.

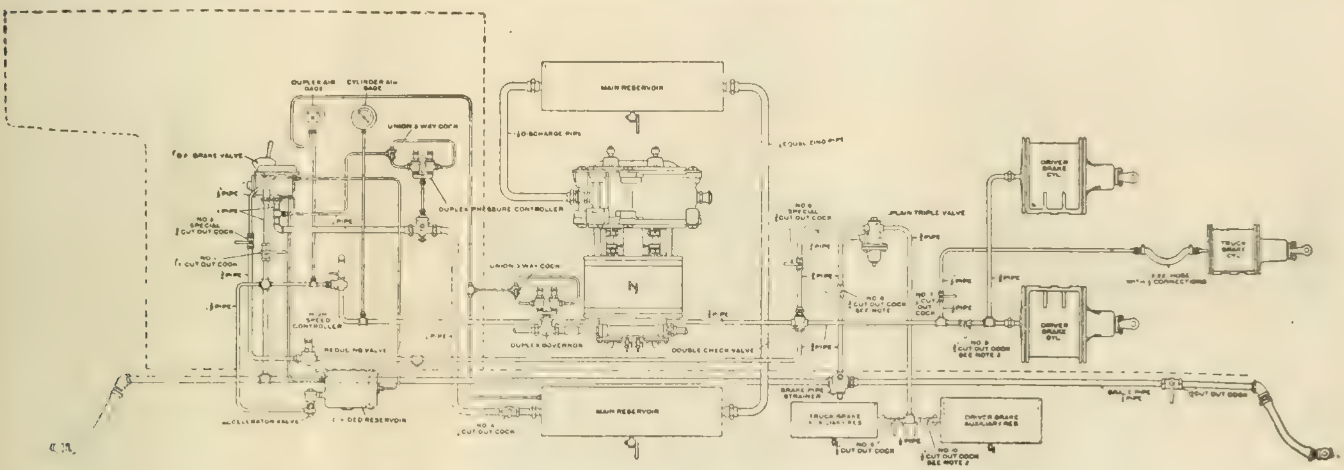
Suppose that the main reservoir pipe should be broken off at the brake valve; at a first glance it looks like an engine failure, but the train can be brought to the terminal with full brake pipe pressure.

As the break occurs the main reservoir and brake pipe pressure will escape and the pump should be stopped, the reservoir cock can be closed to stop the main reservoir leak, and a blind washer should be inserted in the union connection at the brake valve or the opening plugged and the supply valve of the signal reducing valve then removed.

The brake pipe and signal pipe can be connected by hammering the hose couplings on the pilot together, opening the stop cocks on the pilot will then connect the main reservoir with the brake pipe through the signal pipes; the stop cock in the signal pipe at the rear of the tender should be closed. By starting the pump the main reservoir and brake pipe will be charged, and with the brake valve handle in running position the supplementary or smaller end of the divided reservoir will be charged; the pump governor can be adjusted for 70 or 110 lbs. as the case may be, and when ready to apply the pump should first be stopped, except in cases of emergency, and the brake valve handle placed in the graduating notch for which the amount of reduction is desired, and the pressure will be reduced in both the brake pipe and main reservoir, the accelerator valve will assist in the reduction.

If a leak exists at the reservoir union or at the lever shaft, packing that will allow the pressure holding the main slide valve to escape the valve is likely to be forced off its seat during applications, and if any difficulty whatever is encountered in operating the brake valve under those conditions, the stop cock in the straight air pipe and the one in the brake pipe under the brake valve can be closed and the valve handle placed in the emergency position, the reduction in brake pipe pressure can then be made by opening the stop cock under the brake valve.

If the stop cock under the brake valve is of the 3-position type, the brake valve handle need not be removed from running position in order to apply the brake; under ordinary conditions this cock is always open from the brake valve to the brake pipe, must be closed when double-heading, and will in the third position cut off the brake valve, and make an opening in the brake pipe. This style of cock is not placed in the brake pipe because the brake valve is not expected to become defective any more than a train is expected to jump the track on a bridge because there is a guard rail there, but there is always a possibility of a brake valve handle being broken off or becoming disconnected from the valve it operates, therefore the advantage of a stop cock of this kind is apparent. During the reduction the signal whistle would likely blow, but the escape of air would be of no consequence, and when ready to release, the brake would have to be pumped off, the flow of air through the reducing valve even with the supply valve removed is not very free, but the release on occasions of this kind is of secondary importance, the application being the first consideration.



PIPING DIAGRAM OF THE B-2-H S EQUIPMENT N. Y. BRAKE.

The reason for closing the stop cock in the signal pipe at the rear of the tender is that the high pressure might cause another delay by bursting a weak signal hose, and it is not likely that the whistle would respond, anyway when the car discharge valve was opened on account of the volume of air flowing through the signal reducing valve.

BROKEN BRAKE PIPE

If out on the road and the brake pipe should become broken off at the brake valve we would place the brake valve handle on lap position, to prevent the loss of main reservoir pressure, close the stop cock under the brake valve, which would stop the brake pipe leak, plug the broken end of the pipe leading from the brake valve, unscrew the union connection and

cap of the high-speed controller, remove the valve and connect the pipe again; screw down the adjusting nuts on the controller safety valve and straight air reducing valve to create a greater tension on the springs than the brake pipe pressure to be used, and cut out the driver brake triple valve, leaving the bleeder cock open and the stop cocks to the brake cylinder closed. By placing the brake valve handle in realese position, the port in the slide valve seat of the brake valve will be opened, which will allow the air pressure to flow from the main reservoir through the straight air reducing valve, double check valve and the high-speed controller valve into the brake pipe.

The duplex controller will govern the brake pipe pressure, and when the valve handle is placed in running position brake pipe pressure will flow from the brake pipe through the high-speed controller, double check valve, straight air reducing valve, and through the brake valve to the atmosphere, applying the brake.

The triple valve is cut out and the reservoir bled to prevent the operation of the triple, which would build up pressure on the automatic side of the double check valve which would force the valve over and cut off the flow of brake pipe pressure to the atmosphere during applications of the brake.

There can be no driver brake, as the brake cylinder pipes are used to connect the main reservoir and brake valve to the brake pipe. If the tender is equipped with the straight air brake, combined with the automatic, the stop cock in the straight air pipe leading to the tender brake cylinder must also be closed and the hose connections (straight air) between the engine and tender uncoupled to prevent the possibility of leakage past the check valve gaskets, building up a pressure between the check valve and stop cock during the applications of the tender brake, which would operate with the train brake. If pressure was at this time built up in this pipe from check valve or other leakage, it would force the check valve over and cut off communication between the tender brake cylinder and triple valve, when the brakes are released and the pressure could not escape from the cylinder. A brake "stuck" in this manner cannot be bled off; an opening must be made in the pipe on the straight air side of the double check valve. If the special cock of the 3-position type is used it will do this and the hose need not be disconnected.

During applications of the brake the exhaust of brake pipe pressure through the brake valve will be rapid enough to set the brakes on a train of the ordinary length in the service application, and the handle should be moved toward the "lap" position gradually to prevent the "kicking off" of brakes if the exhaust is closed too suddenly; in this case 'lap" position of the brake valve would be midway between release and running positions. When the emergency application is desired the stop cock under the brake valve can be quickly opened, which will have the same effect as a bursted hose or opening the conductor's valve.

BRAKE PIPE BROKEN BETWEEN THE BRAKE VALVE BRANCH AND HOSE COUPLINGS BETWEEN THE ENGINE AND TENDER.

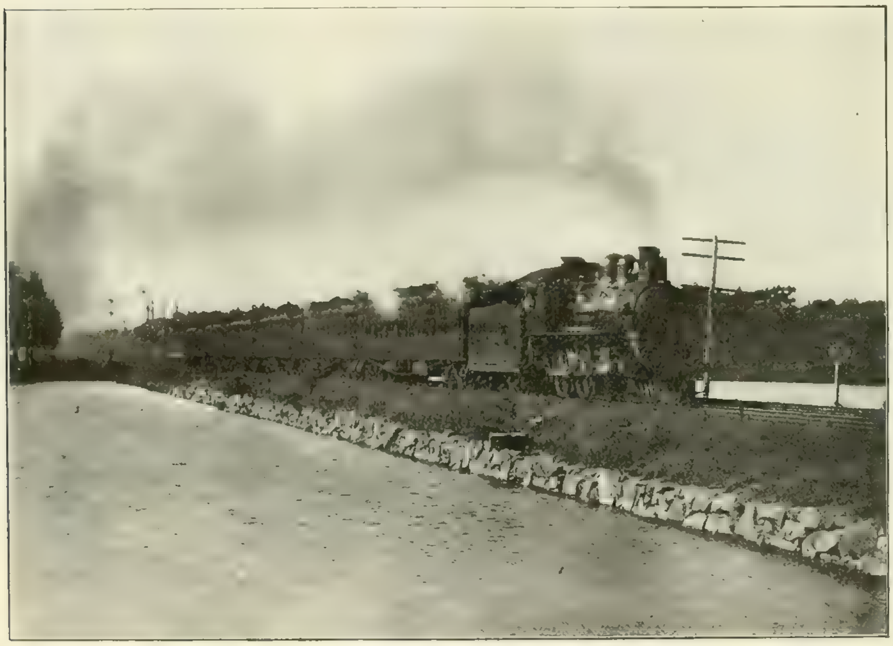
Should this break occur, it will only be necessary to place the brake valve handle on lap position, remove the broken-off pipe and hose, and plug the brake pipe leak, then by hammering together the hose coupling on the signal line rear of engine with the brake pipe hose front of the tender, and hammering together the brake and signal hose on the pilot and opening the stop cocks the brake valve handle can be placed in release position and the pressure will flow from the main reservoir through the brake valve, and brake pipe to the pilot, then through the signal pipes to the brake pipe on the tender and train. When the valve handle is placed in running position the driver brake will be released and the train can be handled in the usual manner.

During an application of the brake the diaphragm of the signal valve may be unseated, but the additional reduction of brake pipe pressure will be of no consequence, and the supply valve of the signal reducing valve will remain closed unless the brake pipe pressure should be reduced below the figure for which the signal line has been adjusted.

BRAKE PIPE ON THE TENDER BROKEN.

If the brake pipe on the tender should burst or be broken, the signal pipes can be used to connect the brake pipe on the engine and train, as in the former case by forcing together the brake and signal hose couplings front and rear of the tender. There will, of course, be no signal whistle in this or other cases where the signal pipes are used to conduct brake pipe pressure, and when the signal pipe under the tender is used in this manner the signal reducing valve must be cut out, or in the absence of a cut-out cock, the pipe at the rear of the signal must be plugged to prevent the escape of main reservoir pressure.

This subject of broken air pipes with the B-2 HS equipment will be continued, and in a future number, handling a train with the brake valve branch of the brake pipe broken between the brake pipe and the connection to the high-speed controller, and handling a train with a broken or entirely disabled brake valve, and some other matters will be taken up.



ASBURY PARK FLYER ON THE PENNSYLVANIA.
(Photographed by Mr. F. W. Blauvelt, New York.)

M. Delagrange, a French aeronaut, has won the prize of 40,000 francs offered by the Aero Club of France for a flying machine that would make a complete circle of over six miles in a certain limited time. M. Delagrange exhibited his aeroplane before a large number of members representing the aeronautical societies of Europe. The successful trial took place in Rome. The machine ran over 100 yards on the ground before beginning its flight. It then rose to a height of about 18 feet and remained in the air 15 min. 26 sec. It circled around the Piazza d'Arme ten times, covering a distance of about 12 miles. It was unquestionably the most successful flight made by an aeroplane. The trials being made in Germany by Count Zepellin with a dirigible balloon, together with the work of the Wright brothers in America, point to an early conquest of the upper air.

Electrical Department

Resistance and Impedance.

By W. B. Kouwenhoven.

When an electric current flows through a wire part of the energy represented by the current appears in the wire as heat. The passage of the electric current is opposed by a property of the wire which is termed resistance. This property of resisting the passage of an electric current is somewhat similar to the frictional resistance offered by a pipe to the flow of water.

In a water pipe, the longer the pipe the greater the resistance offered to the passage of the water, and the resistance offered by the pipe is inversely proportional to its area. There is an exact analogy between the resistance of the wire and that of the water pipe. The resistance of the wire varies directly as its length, and is inversely proportional to its cross sectional area. The resistance of the wire also depends upon the material of which the wire consists. Silver is the best conductor and copper the next on the list. The conductivity of copper varies very much with its purity.

The resistance offered by an electrical circuit is of two kinds; first, there is the resistance of the wire itself and, second, there is the resistance offered by the joints in the wire. The resistance of these joints varies all the way from infinity to an almost perfect contact of negligible resistance. All joints should be either soldered or welded whereever it is possible.

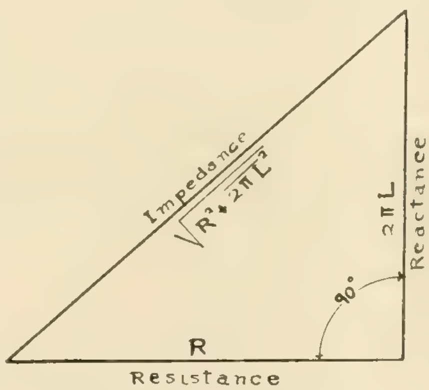
The resistance of a wire depends not only upon its length, size and material, but also upon the temperature of the wire. Most metals increase in resistance as their temperature rises, although there are a few substances whose resistance decreases with a rise of temperature. This change in resistance is approximately constant for each degree of change in temperature, and is called the temperature coefficient of the material.

The unit by which electrical resistance is measured is the ohm. It is easily remembered as the resistance offered by approximately two hundred and fifty feet of No. 16 B. & S. gauge wire at 70 degs. F.

The resistance that is possessed by a wire is the same for both direct and alternating currents. A continuous direct current is a steady non-pulsating current that flows in one direction only, while an alternating current is one that successively changes from a positive value to an equal negative value and back again. The number of times that an alternating current passes in a second from zero to a maximum in one direction, and to zero to a maximum in the opposite direction, and finally to zero again, is known as the frequency of the current in cycles per second. It takes two alternations to make one cycle.

Assume that a coil of wire has a resistance of 10 ohms. A direct current at a pressure of 120 volts would send 12 amperes through the coil. It would, however, take considerably more than 120 volts, alternating current, to send the same amount current through the coil. This is due to the reactance that is offered by the coil in addition to its resistance, to the passage of the alternating current.

Now, the reactance of the coil depends upon the amount of inductance possessed by the coil. When a wire is traversed by a current, lines of magnetism or force



GRAPHIC REPRESENTATION.

emanate from the wire in the form of circular rings; the plane of these rings is at right angles to the axis of the wire. These circular rings go out in very much the same way that the waves radiate when a stone is thrown into a pond. When the current ceases to flow through the wire these lines are drawn back into the wire. The wire in throwing out these lines of force and in drawing them back sets up a voltage within itself. This induced voltage tends to oppose the starting of the current and tends to keep it going when the current dies out. The induced voltage is known as the electromotive force of self induction.

The alternating current in varying back and forth from positive to negative meets the inductance which set up a voltage that acts to oppose the passage of the current through the coil. The amount of inductance of the coil depends upon the number of turns in the coil, the amount of iron about the coil, and several other conditions. The unit of induction is the Henry, and it is usually represented by the letter L.

The amount of reactance offered to the alternating current depends upon the frequency as well as the inductance and it is equal to the frequency multiplied by the inductance, multiplied by twice 3.1416 ($2 \times 3.146 = 2\pi$). The reactance is measured in the same unit as resistance, namely in ohms.

The ordinary resistance offered by the wire to the direct or alternating current may be graphically represented by a straight line drawn to any convenient scale. The reactance which is due to the self induction of the circuit acts at right angles to the resistance. It may also be represented by a line drawn perpendicular to the first line at one end of it. This second line should also be drawn to scale.

These two lines form the two sides of a right angle triangle. To complete the triangle it is only necessary to draw the hypotenuse, and this line represents the impedance offered by the coil. The impedance is sometimes called the apparent resistance. According to geometry, the hypotenuse of a right angle triangle is equal to the square root of the sum of the squares of the two sides. Therefore, the impedance of a circuit is equal to the square root of the sum of the squares of the resistance and of the reactance.

In the coil previously mentioned the inductance is equal to .2 Henrys. At a frequency of 60 cycles per second the reactance of the coil would thus equal $2 \times 3.1416 \times 60 \times .2$ or 75.4 ohms. The impedance equals the square root of the square of the 10 ohms resistance plus the square of the 75.4 ohms reactance. Solving this equation the impedance equals 76.1 ohms. According to ohms law it would take 913 volts of alternating current to push 12 amperes through the coil.

Ohm's law for continuous direct current is:

$$C = \frac{E}{R}$$

And Ohm's law for alternating current circuit having inductance becomes:

$$C = \frac{E}{\sqrt{R^2 - 2\pi f L}}$$

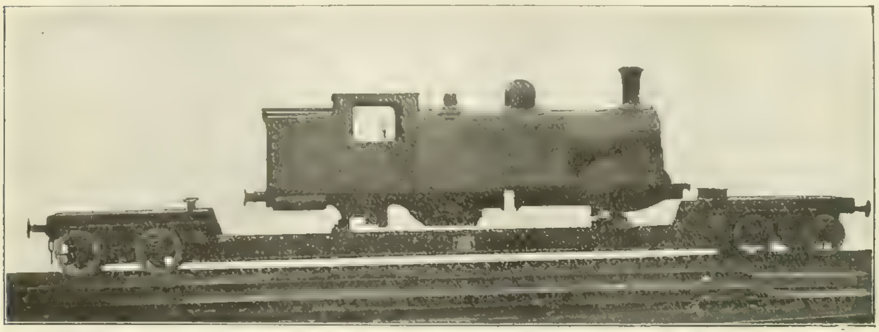
where

C = current in amperes.
E = impressed voltage.
R = resistence in ohms.
f = frequency of alternating current.
L = inductance in henrys.

It must be remembered that circuits only offer reactance to alternating currents. In the case of continuous direct

currents the frequency is zero and the reactance in the formula drops out.

The purpose for which resistances coils are manufactured are numerous. When several resistance coils are grouped together with contact points over which an arm moves the combination is known as a rheostat. Rheostats are used in every electrical field from the experimental laboratory to the large central power station. Their principal use in railroad work is to vary the voltage of a current on the motor car they serve to reduce the voltage at the start and to permit the gradual applicaion of power to the motors.



NOW CARRYING WHAT MAY ONE DAY PULL IT.

A rheostat or resistance coil must be simple, strong and durable. The insulating material must be of good quality and must be able to withstand heat, and above all the rheostat must carry its rated load current without over-heating.

Resistances should not remain in service for great periods of time because of the energy consumed by them. The power lost in a resistance is equal to the square of the current in amperes multiplied by the resistance in ohms. Rheostats are not economical and are usually cut out of circuit as soon as it is safe to supply the full voltage to the machine which is being started. They nevertheless provide a very simple and safe means of applying the voltage to a motor, step by step, and gradually bring it up to speed and to full voltage.

The ordinary rheostat is seldom used for alternating currents for which a special type is employed. The resistance that is designed for alternating currents is usually called a choke or impedance coil. Impedance coils are employed in starting motors in order to reduce the voltage, but they have other characteristics which make them valuable for other uses.

A choke coil is, essentially, simply a number of turns of wire. Choke coils for lightning arresters are sometimes wound as a spiral and sometimes as a helix. They are often used in conjunction with lightning arresters or transmission lines. They are made of flat copper strips when spirally wound, and several of them are connected in series between the line and the machine to be protected. A lightning arrester is connected between them and the ground. Now, under certain conditions a lightning discharge may pass the arresters that are supposed to protect the line, and come into the central station. The inductance offered by the choke coil to the line current of the ordinary low commercial frequency is negligible, but lightning is a current of enormous frequency. The discharge comes into the station on its way to the earth and meets the choke coil which it is unable to pass because of the reactance offered by the coil to the high frequency of the discharge. The lightning then is forced to find a path through the arrester to the earth and thus is prevented by the choke coil from passing into the station and doing any damage to the generators.

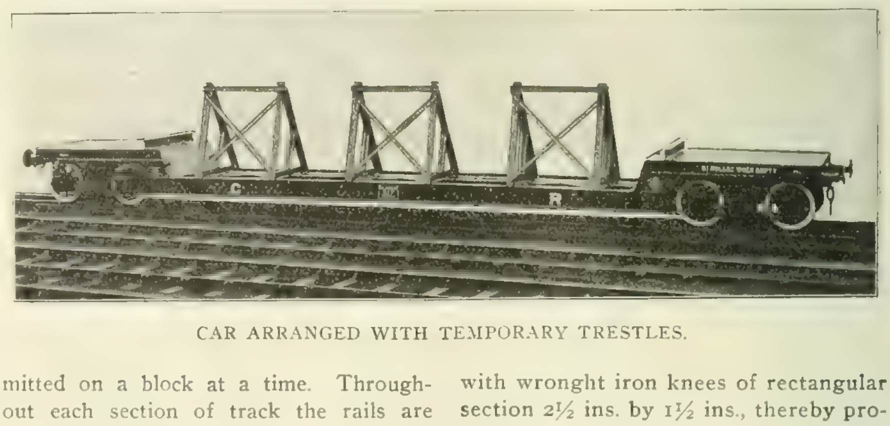
In some systems of automatic railway signaling where the track is used as the negative return to the sub-station, and alternating current is used to operate the signals, the choke coil plays an important part. The track is divided into blocks or sections; only one train being permitted on a block at a time. Throughout each section of track the rails are bonded together in the ordinary way. At the end of each block the rails are bonded to the rails of the next block by what is known as an inductive bond. These inductive bonds are in reality choke coils and offer but very little resistance to the passage of the direct current on its way to the sub-station, but they will not permit the passage of the alternating current which operates the signals from one section to the next section. Thus each section of the track is separated from the other as far as the alternating current is concerned, but the direct current can pass through without any interruption.

The action of a choke coil may be compared to a sieve in which is placed two different sizes of stones. The large stones represent the alternating current and the small stones the direct current. The mesh of the sieve corresponds to the reactance of the choke coil, and prevents the passage of the large stones, while allowing the small stones to pass freely through. One may almost say that the choke coil filters the electric flow. The direct current goes through while the alternating is held back as the solid matter in water is held back by filtering material.

Car for Exceptional Loads.

We are able to illustrate a special car, through the courtesy of Mr. J. F. McIntosh, the locomotive superintendent of the Caledonian Railway. It is a new type intended particularly for the conveyance of armor plate and miscellaneous iron and steel plates of exceptional dimensions, and up to 30 tons' weight. The car measures 61 ft. 8 ins. over the buffers, and is carried on two four-wheel bogies of the diamond frame pattern, the wheels of which have cast steel centers and journals 12 x 6 ins. diameter.

The well consists of four girders of I-section 1 ft. 4 ins. deep by 6 ins. broad, strengthened by riveted plates on top and bottom flanges. The center girders extend close to the inside axles, and are placed at 1 ft. 6 in. centers, in order to afford sufficient side play for the wheels when taking the sharpest curves. The girders are tied together with wronght iron knees of rectangular section 2½ ins. by 1½ ins., thereby providing a clear space of 35 ft. in length between the center and side girders, and at a height of only 10 ins. above rail level, thus accommodating the utmost sizes of plates possible with the gauge limitations.



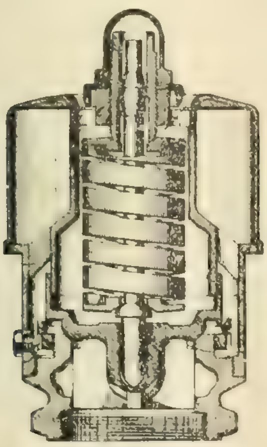
CAR ARRANGED WITH TEMPORARY TRESTLES.

The trestles shown on the car can be readily shifted from one side to the other to suit loading requirements, and may be removed when necessary.

Patent Office Department

SAFETY VALVE.

J. C. Blanchard and P. G. Darling, Bridgeport, Conn., have patented a safety valve, No. 889,895. It consists of a casing provided with a valve seat, a valve co-operating with the valve seat, a spring casing mounted on the valve casing and having an annular skirt projecting toward the valve, a muffler mounted on the spring casing with steam passages between the outer wall and the annular skirt of the spring casing. There are, also, passages from the steam passage to the muffler. The valve has a flange projecting into the steam passage and in sliding engagement with the annular skirt. An ad-



NEW SAFETY VALVE.

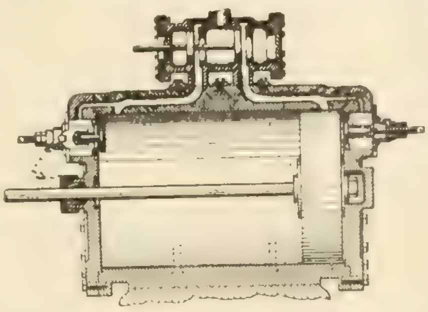
justing ring is attached to the outer lip of the valve, and being provided with a rim, constitutes, together with a flange of the valve, a flaring nozzle that facilitates the free flow of the steam after it leaves the valve seat.

BRAKE SHOE.

S. A. Crone, New York, N. Y., has patented a railway car brake shoe, No. 889,510. The device comprises a brake shoe having a cast-metal body and plate back, the back having between its center and ends inwardly depressed edge portions over which the cast metal extends and the outer edges of which portions are integral with the plate. The plate being less in width than the body, the back is furnished with headseats at each side of its center and at its ends, and are depressed to clear the brake-shoe head.

CUSHIONING VALVE.

A cushioning device for pistons has been patented by A. S. Pike, Malden Mass., No. 886,402. The device embraces in addition to the usual form of cylinder and piston and valve controlling the admission and exhaust of the

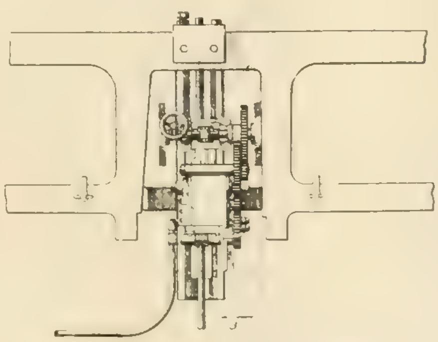


CYLINDER CUSHIONING VALVE.

motive fluid to and from the cylinder, a valve for cushioning the piston at the end of its stroke, and means for adjusting the valve. These valves are attached to the upper ends of the cylinder and are furnished with springs which aid in cushioning the piston.

FRAME GRINDER.

A machine for facing locomotive frame jaws has been patented by Alex. Forsyth, Aurora, Ill., No. 888,604. The machine which has the general form of a cross, one end of one arm of the cross being adapted to engage the base of the frame, and the ends of the other arm being adapted to engage the sides of the frame. A carriage is mounted on the cross frame and adapted to reciprocate parallel to the legs



MACHINE FOR GRINDING FRAMES.

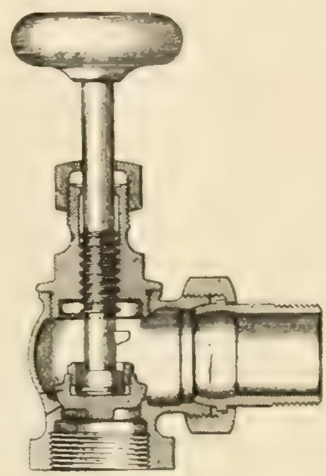
of the frame. A transverse shaft on the carriage having grinding wheels at each end is driven by a motor.

TRAIN STOP.

An automatic train stop has been patented by J. H. Lynch, Red Bank, N. J., No. 891,556. The device embraces a combination of a vehicle power controller, an actuating motor operating on the same to throw off the power, controlling devices controlling the application of the motive agent to the actuating motor, and resetting mechanism adapted to reset the controlling devices and cut off the flow of the motive agent when the motive power controller has moved to a predetermined extent.

VALVE.

R. T. Crane, Chicago, Ill., has patented a valve, No. 891,672. As shown in the illustration, it comprises a body provided with a valve seat, a bonnet, secured thereto and provided with a projecting stop member at its lower side, a valve stem threaded through the



ANGLE VALVE.

bonnet and carrying at its lower end a valve disk, and a stop secured to the stem above the disk and adapted to engage the stop member along a surface parallel to the axis of the stem when the disk is in open position, whereby binding due to changes in temperature is avoided.

Train Coming.

A traveler waited at a certain English provincial town in vain for the much overdue train on the branch line. Again he approached the solitary sleepy-looking porter and inquired for the twentieth time, "Isn't that train coming soon?" At that moment a dog came trotting up the line, and a glad smile illuminated the official's face. "Ah, yes, sir," replied the porter, "It'll be getting near now. Here comes the engine driver's dog."—*The Argonaut.*

General Foremen's Association.

(*Continued from page 339*).

from distant lavatories in the great majority of modern shops than one has any idea of. Twenty minutes from work to work on a trip of this kind is not at all extraordinary, and on investigation has been found, in most cases, to be really legitimate and necessitated by the inadequacy of arrangements. Ordinarily shop cupboards are placed in lavatories for the employes. I have never yet been in a shop where the ratio of cupboards was nearer than one to two for each employee. Why not have enough? All of these criticisms tend to directly increase the advantages to be derived from small shop construction. Ordinarily the criticisms above mentioned which would hold good with the larger shop construction do not obtain with the smaller. Then again it is the tendency of the present time to centralize the manufacture of locomotive repair parts and tools used on railway systems in some one or two plants on the system. This manufacturing work carried on in conjunction with repair work in one shop results to the disadvantage of the repair gang or to the disadvantage of the point out on the line that is waiting for the material. It doesn't work properly. It seems as though it would be wise to centralize the manufacture of repairs in some one shop where no repair work whatever is done. Conduct a manufacturing shop pure and simple and good results will be obtained; in fact the same results that a commercial manufacturer gets, because there is nothing to distract his attention from the new work on hand. I also believe that even in the centralization of manufacturing (which is distinctly an advantage) that all the manufacturing should not be done in the one plant. There are a great many times when the work doesn't balance, when the erecting floor is waiting for the machine side or the machine side is not crowded, owing to the conditions on the erecting floor, which are unavoidable and cannot be foreseen; then each shop should be allowed two or three, or possibly more, specialties of manufacture. For instance: Take one of the outside shops of a division on which are operated a number of engines of one class; let us say then that this shop be allowed to make and furnish for local or general consumption, piston heads, piston rods, main rod brasses and wrist pins in the rough for this one class of engine. This work to be sandwiched in between jobs and at odd times in order to secure to that shop the maximum labor for each man employed all the time. I consider that an arrangement of this kind could not but result advantageously. Very few modern shop builders seem to appreciate the benefits to be derived from industrial railways (with curves and switches always, rather than turntables) on which may be operated storage battery electric locomotives with which to handle the narrow gauge cars that are used. The saving over the old method of push cars with men as the motive power will be something enormous, and there is no place where the small industrial cars may not go. The installation of a sufficient number of cranes in every shop is of prime importance. The time that an employe waits for crane service is absolutely lost. I have no doubt that in almost any modern shop, and certainly in the majority in which I have been, the time that is lost would pay for an additional crane and its installation in one year.

I have endeavored in this paper to cover the principal points of difference between the small and the large shop and some of the faults of the large shop as well. Trusting that the paper may bring out some points which will be of interest to future shop builders and therefore of benefit to those intrusted with their management, it is placed before you for such consideration as you choose to accord.

E. F. Fay.

Cheyenne, Wyo. Union Pacific Ry.

TOPIC NO. 4—THE APPRENTICE QUESTION—HOW CAN WE OBTAIN THE RIGHT KIND OF MATERIAL AND HOW CAN WE KEEP THEM INTERESTED? THE BENEFIT OF NIGHT SCHOOLS FOR APPRENTICES MAINTAINED AT COMPANY'S EXPENSE—DOES COMPANY OBTAIN SUFFICIENT BENEFIT TO WARRANT THIS EXPENDITURE?

The apprentice question has been engaging the attention of railroad men as well as the manufacturing corporations for the past eight or ten years and many prominent railroad men have been giving it very serious attention for the last four or five years. Several manufacturing corporations have quite elaborate systems for the instructing and educating of their apprentices and at the present time several of the large railroad corporations are establishing apprentice systems. There is very evident need of such systems when we consider what is required at the present time.

For years past large amounts of money have been spent by the American railroads in perfecting rolling stock and in fact all equipment for the perfect and speedy operation of trains. The success, however, of all mechanisms and equipment in the end depends upon the intelligence with which they are handled, and no more important subject, I believe, is before the railroads to-day than that of the apprentice question.

Railroads have spent large sums also in equipping shops with high speed steel and heavy duty machinery, but if the intelligence and efficiency of the mechanics do not progress in a like degree, with mechanical improvements, there is still a lack of efficiency and an unbalanced condition.

It is also not so much a question of today as it is of the future and the place to start is with the boys by some rational apprentice system. The old way of hiring a boy out as an apprentice and leaving him entirely to himself to pick up such information relative to his trade as he could or as the foreman was pleased or had time to give him, is entirely inadequate to meet the demands of modern times or prepare for the future.

The apprentices that are now our mechanics were developed in practical skill only, unless by their personal effort they worked out such knowledge as they could in their spare time evenings. They were expected to become journeymen in from three years to a life-time and the proficiency developed depended entirely on their own energy and personal effort. The result has been a body of journeymen about as varied as it is possible to conceive.

I do not claim, however, even with a modern apprentice system and methods of instruction that all apprentices will be developed to an equal degree of proficiency. This is just as impossible as it is for all men to think alike. What the apprentice system does do, however, is to give the ambitious apprentice a chance to advance as fast as he is desirous of doing in his four-year course, and through the personal effort of the instructor in charge of the work it brings the slower ones to a higher degree of proficiency than they could ever obtain being left to themselves.

In a rational apprentice system, there is no stopping or graduating position. What is desired and aimed for is greater output and better work continually, and to produce this requires greater skill and more intelligence. I do not believe a system founded on college methods or even on high school methods will meet the present demands of the apprentice and interest him. I believe it is necessary to start from the beginning and by a system of development introduce such learning as the apprentice can see the actual need of in his everyday work.

No formal or initial examination will give us a correct line to draw in the employment of apprentices. It will give us a knowledge, however, of how the apprentice has been spending his time previous to entering the apprentice ranks.

The question of interesting the apprentice and keeping him interested is a matter of showing him the way by opportunities presented to him and not by forcing him along any particular line of advance-

ment. If the opportunities for advancement as given in the New York Central Lines Apprentice System are not sufficient to interest the apprentice of the present day, I am at a loss to say what will. The apprentice will not appreciate a lecture or class work as he would individual attention. By the system of instruction in the shop by a practical mechanic, and a period twice a week, for instance, in a drawing class with personal instruction from someone competent and interested in the work, I believe any body of apprentices should become interested.

Another feature which I believe is important in any apprentice system is systematic and periodical changes in all branches of the trade to be learned. This opportunity was not given to the old-time apprentice, or even the apprentice of late years. For example: within the past two years a young man presented himself at a railroad shop for employment, and after stating that he was just out of his time, he was asked the question, "Why is it necessary to lay out shoes and wedges on a locomotive?" and after hesitating a little, the young man replied, "So the engine will not sound lame."

The benefit of night schools for apprentices is doubtful. I do not believe it would give as much benefit to as many apprentices as a school maintained at the first part of the working day. A boy, when through with the day's work in the shop, unless he is a rare case, is ready for recreation of some kind rather than classroom work, and while there is no doubt that night schools do a great deal of good to both apprentices and mechanics who attend of their own accord, I do not believe they are practical for the whole apprentice body. It is, therefore, a question as to whether the company obtains sufficient benefit to warrant the expense and the reply to this I would prefer leaving to local shop managements.

However, if I may be permitted, I would like to say that a stated period of instruction to apprentices at the beginning of the day is surely going to pay for itself inside of a very few years, if it is not doing so already. While it is a hard matter to get an accurate line on, it is evident where this has been tried that it pays in conjunction with other features of a modern apprentice system, inasmuch as a great amount of money is saved by eliminating a per cent. of spoiled work, and I can say from experience that spoiled work has been reduced to a surprisingly low per cent., due to the methods of systematic shop instruction. Another and apparently fully as important source of benefit is derived from the increased output. An apprentice, if left entirely to himself when given a new job, will naturally approach it with timidity and is pretty well occupied in avoiding trouble with both the machine and the work and consequently does not work the machine or the tool to the full capacity. At the same time, if, under the old methods, the foreman starts the job with him, the shop loses the benefit of that foreman's supervision during that time. With a system of instruction that will teach the apprentices these points, the amount expended for instruction, I believe, is certainly a profitable investment for the company in saving of tools, and work and the increase in the output.

There is one more point I would like to bring out in connection with interesting the apprentice and that is to try to avoid employing those apprentices who are not naturally inclined to become interested. In order to accomplish this, I have seen a system worked out whereby prospective apprentices are hired as oilers and to run light machinery, such as bolt cutters and nut tappers. By the shop instructor observing such boys for a period of from three to six months, it should be a very rare occurrence to allow a boy to enter the apprentice list who shows no aptness for the trade. The particular case of running nut tappers or bolt cutters refers to only one trade, but the same principle can be applied to any or all trades in the railroad shops.

I am not in favor of offering any financial bonus to apprentices on the completion of their time. I would consider each apprentice hired to be on a six months' probation. If during that time he shows himself apt, I believe that is sufficient to warrant carrying him to the completion with the ordinary amount of disciplinary methods. At the completion of an apprentice's time, I would give him papers signed by the local as well as the general officials under whom he has served his time.

A. O. Berry,
L. S. & M. S. Ry.

Elkhart, Ind.

TOPIC NO. 4 CONTINUED.

Now, as the selection of young men of the proper calibre and ambition to make good mechanics is a problem that has occupied considerable time and thought of our most successful manufacturers for years, who have foreseen the necessity for the educated mechanic and they have gone so far as to attach schools to their shops for the education of apprentices, but I believe the most of them have been abandoned as an expensive experiment, owing to the indifference or lack of interest of the average apprentice boy of to-day, who generally is the son of an employe, who gets the opportunity to learn a trade through the long and faithful service of his father, or some other relative, and ofttimes through this, the young man is placed at a trade which he has no desire to learn, and this is more particularly the case in the railway shop, than with the manufacturers or private shops, and, owing to the laxity of rules between the different railways in reference to the hiring of mechanics, the average young man leaves his trade when he has served about two years and goes to the next railway shop and hires out for full pay as a mechanic, instead of serving the full term of four years.

Now, I presume someone will say, "how can they get along", well, the apprentice of to-day joins the union the first year he is in the shop and about one-half of the men in the railway shops are of the same class. They try and carry him along, and, as a rule, giving the company a poor class of mechanics and bad service, for which the railways themselves are to blame, as their rate of pay is most always below that of the manufacturer or private shops, who take the choice of the mechanics and the railway shop gets what's left. However, I will attempt to give you a few ideas that appear to me at this time and if they should suggest anything that will help you out in compiling your report, for the betterment or efficiency of the service, we shall all feel that we have been well rewarded for any time spent in the cause.

SUGGESTIONS AS TO RULES AND REGULATIONS OF APPRENTICES IN RAILWAY SHOPS.

In my opinion, it would not pay a railway company to maintain a school at their shop, for the technical education of apprentices, as now handled, as about eight out of every ten young men that start to serve an apprenticeship nowadays, are very indifferent to study and not very ambitious to learn the practical part of the trade, and if they serve four years, they generally quit, and go to some other shop, through the advice of their associates, who tell them they must travel and work in other shops to get experience and in such cases the company who maintained the school would derive no benefit for their expense, but I believe that it would be beneficial to the railway company to furnish, through the drawing department, about two lessons a month to each apprentice for home study, and when finished they be returned for examination by the mechanical draughtsman, who would mark them a percentage, according to the quality of the work. This would be a means of inciting the young men to self-study and teach them to correctly read drawings. This would cost the company very little, as one set of tracings would do for blue prints for all time, as copies of lessons.

No apprentice should be hired to the machinist's trade under sixteen (16) years. He should be of good character and should have passed the primary grades in school in writing, reading, arithmetic and drawing. He should be hired on three months' probation, to give him an opportunity to decide if he is satisfied to learn the trade and the employer to satisfy himself the young man has the proper quali-

fications for a mechanic. Then, after three months, if agreeable to both parties, there should be some form of contract to be filled out and signed by the apprentice and his guardian and the employer, setting forth that the young man would serve four years apprenticeship, of not less than three hundred (300) days each, for which he shall receive .... per hour, first year; .... second year; .... third year; .... fourth year and the minimum mechanics' wages to start the fifth year. For the faithful performance of his duties and living up to the rules of the company, at the end of four years, he shall receive one hundred ($100) dollars as a premium, as I think the one hundred dollars would be an inducement for the faithful performance of the contract and would bring double returns to the company, and, at any time after signing the contract and before the expiration of four years, it can be annulled by mutual consent by the apprentice signing a contract that he will not enter the employ of any other firm at this particular trade and forfeit all claims to the premium. The apprentice is to be given every reasonable opportunity to learn the trade and changed at least once in six months to a different branch of the trade.

W. POHLMAN,
N. Y. O. & W. Ry.
Middletown, N. Y.

TOPIC NO. 4 CONTINUED.

The average force of apprentices found in railroad shops may be divided into four classes as follows:

FIRST CLASS.

Boys who have had the advantage of fair technical educations, and occasionally some experience in a drawing office, who, thus well equipped, enter the shop for the purpose of gaining the practical experience which they have found to be so necessary to a successful mechanical career.

These boys are generally older than the ordinary apprentice at entering, and are steadier and more appreciative of the opportunities presented to them, applying themselves industriously to the work, and wasting no time in acquiring the practice they are hungry for.

Some individuals of this class may try to impress the foreman or instructor in charge with their superior technical knowledge, even to the extent of becoming annoying at times, but by careful handling these lofty ones may be gradually brought down to their proper level without damage, so that by the time they have finished their apprenticeship, they are found to be good all around men, well balanced, and fitted for more or less responsible positions.

As a whole this class will be found to be more efficient than any other, and the boys might be obtained by keeping in touch with the heads of the different technical schools.

Numbers of these boys are at present forced into other lines of business, through lack of influence to get them into shops where they might follow the work for which their education has specially adapted them.

SECOND CLASS.

Sons of mechanics whose fathers and grandfathers were in the trade before them, and who though generally possessing nothing more than ordinary common school educations, and often not much of that, nevertheless enter the shop at an early age, mechanics by right of birth, ready to develop a talent, handed down to them by heredity through generations of mechanics. They have lived in a mechanical atmosphere and have listened to shop talk since they were born. These are the boys who take to the work naturally, and who, if given the opportunity to acquire a technical education, gladly avail themselves of it, realizing the deficiency in their educations more and more as they advance and come in contact with problems, which bother them, but which they see their shopmates of the First Class handle with ease.

To obtain boys of the Second Class, the foreman or instructor should inquire of their fathers in the company's shop and others in the locality, and keep well posted on the amount and age of this growing timber.

THIRD CLASS.

This class is made up of sons of officials and employes in various branches of railroad service other than mechanical.

These boys have not had the mechanical advantages of those in either of the preceding classes, although many of them may have received better general educations, but not with any particular trade or business in view, and after having dabbled a little in this or that occupation, are sent to the shop as a last resort.

The whole class is virgin soil, and partakes more or less of the nature of a grab-bag, containing some prizes and a good many blanks.

In point of numbers, this class is usually the largest in the shop, and may finally turn out as many good men as any of the others. It is up to the foreman to separate the sheep from the goats in the developing process, and when a boy is found, who after a fair trial finds the work uninteresting and simply drudgery, it is best for that boy and all concerned that he be relieved at once.

It is not a difficult matter to secure boys of this class, as they usually come unsolicited and plentifully.

FOURTH CLASS.

This brings us to the fourth or last class of apprentices—the sports.

These are the young men who might, under normal conditions, be placed in some one of the preceding classes, but who, owing to their fondness for staying out all night, must needs be plaecd in a class by themselves.

The writer has known boys of this stamp who would have some business of a sporty nature to attend to every night in the week, from a beer garden dance down to a chicken fight, and then come to the shop next morning, looking and smelling bad, with the one idea of finding some out of the way corner where they might obtain much-needed sleep undisturbed, and be prepared for the next night's activities. Have known the space on top of the flues in a locomotive boiler to be converted into a boudoir, by the inexpensive addition of a piece of burlap, and the proprietor sleep peacefully therein all day long with his check in his pocket.

Very few of this class come to realize the folly of their ways till too late, and the sooner they are weeded out the better for all concerned.

I am now speaking of the "natural, born, dead game sports" and not of the boys who occasionally are led astray and go on a payday spree, losing the next day to sober up in.

They are at least decent enough to stay away till they are fit to be seen, and honest enough not to expect their employers to pay them while sleeping off the effects of a debauch.

It is needless to advise where apprentices of the Fourth Class may be found. Nobody needs them, but they creep in among the others and every shop is likely to enlist a certain percentage of them unknowingly.

TO OBTAIN THE RIGHT KIND OF MATERIAL FOR APPRENTICES.

It would seem that too much care cannot be exercised in enlisting apprentices, so as to feel reasonably sure that you are getting good material to start with, that your sweetness may not be wasted on the desert air.

In this connection, it might be well to get out printed application forms with a footnote or fly leaf setting forth the requirements, rules, advantages, wages, etc., and have these distributed among technical schools and other educational institutions for boys, including orphan boys' homes, also to agents along the line of road, and to any others where the advertising matter would be likely to bring results.

Applications should be accompanied by proper vouchers as to character, and if the applicant lives in the vicinity of the shop, the foreman or instructor should, if possible, make personal efforts to become acquainted with his habits and morals.

Before entering the shop, applicants should be required to pass an examination in simple arithmetic, reading, writing, and spelling, but this examination should be

stiff enough to insure keeping out boys with practically no education.

TO KEEP APPRENTICES INTERESTED.

This question brings the foreman or instructor in charge to the front. Much, if not all, of the responsibility is his. Heaven help him.

In addition to his being a capable, all round mechanic with a good technical education, he should be a man of high moral character, able to command the respect of his boys at all times, also a close student of human nature, especially that part of it which pertains to boys between the ages of sixteen and twenty-two years, or thereabouts.

He must look backward to the time when he was a boy, and be prepared to make all due allowance for their shortcomings and failures, but on the other hand not forgetting the hard knocks in the line of penalties imposed for like failings at the same critical period in his own life.

Strict discipline should be maintained at any cost, and to this end it is not good for apprentices to join labor unions, neither is it a good thing for the management of a shop to allow labor unions to dictate to them in regard to the number of apprentices there shall be in the shop.

The chief cause for flagging interest in an active, ambitious apprentice is the fact that he is often held on one class of work long after he has become thoroughly proficient in that work, and feels that he is losing valuable time.

This practice may show greater efficiency for the machine in the course of time, but it is hardly just to the apprentice. His advancement should be as rapid as possible, consistant with his ability. Occasionally this method may necessitate pushing a boy ahead of the one next above him, but a dull boy canot expect to hold all below him back, till he has absorbed sufficient knowledge and practice to warrant a shift.

"Variety is the spice of life," and so it is with apprentices.

BENEFIT OF NIGHT SCHOOLS FOR APPRENTICES MAINTAINED AT THE COMPANY'S EXPENSE. DOES IT PAY?

I think not. Night school maintained jointly at the expense of the company and apprentices have proved failures in the long run, but accepting the general principle that "where a man's money is there is his heart also," it would, at first sight, seem that these schools should be successful.

But we are not dealing with men, we are dealing with boys, who have not yet learned the value of money, and who, as a rule, would sooner have their evenings to themselves, to be devoted to pleasure rather than to study, and are ever ready to make the necessary financial sacrifice, so that if they are willing to neglect a night school, maintained partly at their own expense, how can we expect them to do any better with the one which costs them nothing but their own time.

Then again, school work, and especially mechanical drawing by artificial light, will slowly but surely damage the best eyesight, and in a great many cases, not so slowly either. This I can vouch for, to my sorrow.

If the company is willing to maintain a night school, why not go a step further and maintain a day school, along the lines adopted by the New York Central and other large roads, which schools are known to be successful.

The instruction is not only free, but the boys are paid for attending school, during regular working hours, and cannot get out of it.

Such educational systems as have been inaugurated by the large roads, may prove too elaborate for smaller ones, but the same general principles might be followed in modified form to suit conditions, with beneficial results to the company and apprentices alike.

The paper entitled "The Apprentice System on the New York Central Lines," by Mr. C. W. Cross, Supt. of Apprentices, read before the Twentieth Annual Convention of the American Master Mechanics' Association, which, with the subsequent discussion, was published in the Report of Proceedings for 1907, covers the whole ground in detail, and to which I would respectfully refer all interested persons.

W. G. LARMOUR,
N. & S. Ry.

Norfolk, Va.

TOPIC NO. 4 CONTINUED.

The question of how to obtain the right kind of material for apprentices and how to keep them interested is a question that requires a good deal of study of human nature. We have young men serving apprenticeships in a good many shops that will never make machinists, and then again, there are young men serving time that have push enough in them that will make good machinists. When I have an apprentice that stands in the way of one of these apprentices I make him stand aside. I believe in giving an apprentice a warning and if he does not heed it he should be taken out of the ranks. As a rule he should have an eighth grade school certificate before entering the employment of the company and be seventeen years of age and have good habits and should be under inspection as to what company he keeps.

I change apprentices every ninety days to different work. I find it a good plan to keep them interested. A good many shops turn out machinists that have only had either machine or floor experience, and I think that this is an injustice to the apprentice. I think that the General Foremen's Association should go on record this coming convention to have all railroad companies issue a certificate stating how long the apprentice has served in the various branches. I believe if this was suggested to the different Master Mechanics, they certainly would be in favor of it, as it would have a tendency to stop many of the apprentices from leaving the shop before they have served their time. Then again, the railroad company would not have to try the man as to his qualification.

The rules of the Pere Marquette Railroad Company governing apprentices are as follows:

First 6 months in tool room. Rate 75 cents per day.

Second 6 months, nut tappers, bolt cutters and small drill presses. Rate $1.00 per day.

First 6 months second year, bolt lathes and other small tools. Rate $1.25 per day.

Second 6 months second year, shapers, planers and milling machines. Rate $1.50 per day.

First 6 months third year, piston lathe, packing lathe, wheel lathe. Rate $1.75 per day.

Last 6 months third year. Erecting floor. Rate $2.00 per day.

First 6 months fourth year, rod work, eccentric work, valve setting. Rate $2.25 per day.

Last 6 months fourth year and all of the fifth year, general floor work. Rate $2.40 per day.

Thus you will see it requires five years, which I think is a very good schedule. I warn all foremen to explain all workings of machinery, grinding of tools, the quickest manner of chucking work. A foreman should at all times feel that he has a special interest in an apprentice and if it is appreciated by the apprentice he will make a good machinist.

In regard to night schools maintained by the railroad companies, I think they are very beneficial. The Pere Marquette Railroad Company gave me permission to start a school at Wyoming where the shops are located, which is about three miles from the city. We have a dummy that runs every half hour and carries the men to and from the shops. We hold a school in mechanical drafting once a week, the railroad company furnishing everything. We have a good attendance, and I believe the company will benefit by it. We have a class of 53 members, 29 of whom are apprentices. I insist on the apprentices attending this school, and so far it has been beneficial.

W. C. GROENING,
Pere Marquette R. R. Co.

Grand Rapids, Mich.

This concludes the papers presented at the General Foremen's Convention and this and our July issue form a complete record.

Idaho & Washington Northern 4-6-0.

The Idaho & Washington Northern Railroad have recently received from the Baldwin Locomotive Works, two ten-wheel locomotives for passenger service. These engines are employed on a line having four per cent. grades and 16 degree curves. They can exert a tractive force of 25,320 lbs., and as the weight on the driving wheels is 108,850 lbs., the factor of adhesion is 4.3. These locomotives are equipped with single-expansion cylinders, having balanced slide valves which are driven by the Walschaerts valve gear. The valves have a maximum travel of 5½ ins. The outside lap is ⅞ ins. and no inside lap, while the constant lead is ¼ in.

The rocker shaft bearings are bolted to the guide yoke, and the combining levers are placed back of the cross-heads. A substantial cross-bearer, placed back of the leading driving wheels, supports the combined link and reversing shaft bearings. The links are of the built-up type, with cast steel side plates and double trunions. The eccentric cranks are also of cast steel. This is a simple arrangement of gear, employing but one reversing shaft, which reduces twisting strains. Cast steel is used on a number of large details in this design, among which are engine frames driving-wheels centers, driving boxes and cross-heads. The equalization system is arranged with leaf springs above the first and second driving axles, and beams over the back boxes. Inverted leaf springs are placed between the main and rear driving wheels, and the frames are supported, at the back end, on coiled springs.

The boiler is of the straight top type, with wide fire box, sloping throat and straight back head. The longitudinal barrel seams are butt jointed and sextuple riveted. The firebox is radially stayed, with one T-iron supporting the front end of the crown. The mud ring is supported by sliding shoes in front and a buckle plate at the rear. The heating surface is in all 2,281 sq. ft., made up of 129 in the fire box and 2,152 in the tubes, which are 14 ft 5 ins. long, 2 ins. outside diameter and No. 12 gauge. There are 287 tubes in the boiler. The grate area is 37.9 sq. ft. and this gives very close to 1 sq. ft. of grate surface to 60 sq. ft. of heating surface. The water spaces around the fire box are 4 ins. in the front and 3 ins. on the sides and back.

The equipment includes automatic and straight air brakes on the driving and engine truck wheels, while the Le Chatelier water brake is applied to the cylinders. A large air drum is hung under the running board on each side, and a third drum is placed between the frames ahead of the main driving wheels. The tender frame is built up of steel channels, and the trucks are of the arch bar type with steel bolsters. The tender wheels are of forged and rolled steel, made by the Standard Steel Works. The tender has a water capacity of 6,000 gallons and carries 9 tons of coal. The weight of engine and tender taken together amounts to 265,000 lbs. The engine presents a neat and well proportioned appearance and is a thoroughly serviceable machine for the work to be done. Some of the principal dimensions are as follows:

Boiler.—Diameter, 62 ins.; thickness of sheets, ⅝ ins.; working pressure, 200 lbs.; fuel, soft coal; staying, radial.

Fire Box.—Material, steel; length, 90 5/16 ins.; width, 60 ins.; depth, front, 61¼ ins.; depth, back, 47½ ins.; thickness of sheets, sides, 5/16 in.; thickness of sheets, back, 5/16 in.; crown, ⅜ in.; tube, ½ in.

Driving Wheels.—Diameter, outside, 63 ins.; journals, main, 8½x10 ins.; others, 8x10 ins.

Engine Truck Wheels.—Diameter, 30 ins.; journals, 5½x10 ins..

Wheel base.—Driving, 13 ft. 6 ins.; total engine, 24 ft. 4 ins.; total engine, and tender, 52 ft. 8½ ins.

Weight.—On driving wheels, 108,850 lbs.; on truck, 37,750 lbs.; total engine, 146,600 lbs.

Tender.—Wheels, number, 8; diameter, 33 ins.; journals, 5x9 ins.

4-6-0 FOR THE IDAHO & WASHINGTON NORTHERN.

W. T. Fitzgerald, Supt. of Motive Power. Baldwin Locomotive Works, Builders.

The Quebec Bridge.

An elaborate and exhaustive report covering more than 1,000 pages has been issued by the Royal Commission of the Canadian House of Commons. The report deals with every aspect of the question concerning the fall of the bridge, and while there is little that is new in the report, there is much that adds to the corroboration of what was formerly conjectured. The bridge was not strongly financed, and the general lightness of the structure was in keeping with this weakness. The originally proposed span of 1,600 feet was stretched to 1,800 feet, without any organic change in the size of the structural members. It appears that the distance added to the original plans increased the stress 29 per cent. and that the bridge, even if completed, could not have resisted this overstressing. The exact point of failure is definitely indicated, but this is of little consequence as the whole structure was weak. The most melancholy detail of the disaster referred to in the report was a loose supervision of the work, as evidenced when the buckling of the first failing strut began. There was no one on the ground sufficiently responsible to stop the work without asking a consulting engineer, who, at the time, was a great distance away. A telegram from this engineer arrived after the bridge had collapsed.

In forging lathe tools a fine surface may be given to the swaged part by using a little oil on the metal while it still retains a dull red heat. It has a particularly fine effect when used on the rounds of the tool by applying the oil to the swage during the finishing strokes of the hammer. This process, like everything else, has to be done carefully but the result pays for the effort.

Items of Personal Interest

Mr. R. E. Fulmer has been appointed master mechanic of the Tremont & Gulf, with office at Eros, La.

Mr. W. F. Perdue has been appointed instructor and examiner on standard rules and signals on the Mexican Central.

Mr. R. Fitzsimmons, has been appointed master mechanic of the Vera Cruz & Pacific, vice Mr. J. H. Gimpel, promoted.

Mr. C. H. Spencer has been appointed engineer of the Washington Terminal Company, with office at Washington, D. C.

Mr. W. F. Purdy has been appointed chief engineer of the Wabash, Pittsburgh Terminal, in charge of construction and maintenance.

Mr. C. H. Hedge has been appointed assistant master mechanic on the Canadian Northern Railway, with headquarters at Winnipeg, Man.

Mr. A. C. Miller has been appointed master mechanic of the Texas Midland, in charge of all motive power and equipment, with headquarters at Terrell, Tex.

Mr. W. T. Fitzgerald has been appointed superintendent of motive power of the Idaho & Washington Northern Railway, vice Mr. W. J. Spearman, resigned.

Mr. R. B. Smith has been appointed foreman of motive power and equipment of the Cincinnati, Lebanon & Northern, at Pendleton, Ohio, vice Mr. John Stutter, resigned.

Mr. J. J. Waters has been appointed superintendent of the machinery of the Mexican Central, with headquarters at Aguascalientes, Aguas., Mexico., vice Mr. Ben Johnson, resigned.

Mr. J. H. Gimpel, formerly master mechanic of the Vera Cruz & Pacific, at Tierra Blanca, has been appointed master car builder of the road with office at Terra Blanca, V. C., Mex.

Mr. F. C. Pickard has been appointed master mechanic of the Mississippi Central and of the Natchez & Eastern, with headquarters at Hattiesburg, Miss., vice Mr. W. J. Hayden, resigned.

Mr. Frank Maher, for a number of years at the head of the motive power department of the Clover Leaf, at Delphos, has been appointed master mechanic for the Chicago & Alton, at Kansas City, Mo.

The title of Mr. D. J. Durrell, general foreman of the Pittsburgh, Cincinnati, Chicago & St. Louis, and of the Cincinnati, Lebanon & Northern, at Cincinnati, Ohio, has been changed to that of master mechanic.

Mr. J. H. Broadbent, assistant signal supervisor of the West Jersey & Seashore Railroad, has been appointed assistant supervisor of signals on the Pennsylvania at Kittanning, Pa., succeeding Mr. D. B. Bartholomew.

Mr. W. R. McKeen has resigned as superintendent of motive power and machinery of the Union Pacific to assume the management of the McKeen Motor Car Shops, which will be established in Omaha, Nebr.

Mr. A. J. Isaacs, foreman of locomotive repairs of the Chicago & Alton, at Kansas City, Mo., has been appointed master mechanic of the Mexican Central, with headquarters at Chihuahua, Chih., vice Mr. S. E. Kildoyle, resigned.

Mr. F. C. Smith, assistant general manager of the Aransas Pass R'd., has resigned to engage in other business. Mr. F. L. Lewis, superintendent of the same road at Yoakum, has been made superintendent of transportation at San Antonio.

Mr. C. F. Fuller, formerly assistant superintendent of motive power, has been appointed superintendent of motive power and machinery of the Union Pacific Railway, with headquarters at Omaha, Nebr., vice Mr. W. R. McKeen, resigned.

Mr. M. E. Towner, assistant to the vice-president of the Chicago, Rock Island & Pacific, has been appointed purchasing agent of the St. Louis & San Francisco, with headquarters at St. Louis, Mo., vice Mr. W. E. Hudson, resigned.

Mr. W. T. Fitzgerald, master mechanic of the Wisconsin & Michigan, has resigned to accept service on the I. & W. N. The position of master mechanic has been abolished. The duties of master mechanic are now performed by Mr. S. N. Harrison, superintendent of the road.

Mr. Cole, the son of Mr. John Franklin Cole, is announced as winner of a Canadian Pacific Scholarship at McGill University. The scholarship entitles him to a course in Applied Science, leading to the degree of B.Sc. The successful pupil is 19 years of age, and was educated at the Collegiate Institute.

Last month we recorded the resignation of Mr. A. Bardsley from the position of master mechanic of the Gulf & Ship Island Railway, at Gulfport, Miss. We have since received a letter from the general superintendent of the road, Mr. G. F. Gardner, in which he states that Mr. Bardsley's withdrawal from the service of the company is due to ill health from which he has been suffering for more than a year past. Mr. Bardsley's resignation has been received with sincere regret by the officers of road, and his speedy recovery is earnestly hoped for. Mr. W. J. Hayden has been appointed as successor to Mr. Bardsley.

Obituary.

The death of George H. Daniels, for many years the general passenger agent of the New York Central Railroad, removes a unique figure from the railroad world. Mr Daniels began the important railroad work of his life in 1872 as general passenger agent of the Chicago & Pacific Railroad, which was then a small road about 40 miles long. In 1880 he became general ticket agent of the Wabash, St Louis & Pacific. Two years after that he was appointed commissioner of the Colorado Railroad Association and to this was soon added the Utah Railroad Association. He held various positions until in 1889, he was appointed general passenger agent of the New York Central, a position which he held with manifest ability for a period of nearly 17 years. In 1906 he was placed at the head of a new department called into being by allied railroad interests known as the New York Central Lines, which had to deal with the important subject of advertising of which Mr. Daniels had proved himself to be a past master. His ability as an advertiser did more to make the Empire State Express, with engine 999, and the N. Y. C. trains known all over this land and foreign countries as well. In 1907 he retired from the active management of this department. He spent his retirement at a beautiful spot on Lake Placid, in the Adirondacks, which he had made his home; and his death, which occurred a short time ago, comes upon his many friends like the removal of a time-honored landmark and the dropping of a well-known name.

It is with regret that we have to record the death of Dennis S. Dockstader, formerly general foreman of the car department of the Erie Railroad. Mr. Dockstader died at his home at Meadsville, Pa., on the 13th day of July, at the age of 78. In 1862 he began work on the Atlantic & Great Western, which is now part of the Erie. He was master car builder for the Erie for 20 years. He went to Kent, Ohio, in 1887, and became general foreman of the car department, retiring from active duty 12 years ago. Mr. Dockstader built the only private car ever owned by the Atlantic & Great Western. Later, the car was used as a station and office at Marion, Ohio, and is now used in a similar way at Columbus, Pa. When the new Columbus station is built the old private car will be taken to Susquehannah, Pa., for preservation.

The Care of Locomotive Boilers

STAYBOLT BREAKAGE

By

F. P. Roesch, Master Mechanic Southern Railway

The failure of stay bolts is not always given the same prominence as the failure of flues, for the simple reason that a staybolt failure very seldom results in an engine failure, yet when we take into consideration the fact that as an item of expense in the care and maintenance of boilers the staybolt, especially on high pressure boilers, runs the flue a close race, and in some localities is even more expensive, it is patent that from a dollar and cents point of view alone, it is worth our every consideration.

Owing to the increase in steam pressure, together with the increase in boiler dimensions of the modern locomotive, the renewal of broken stay bolts is becoming quite a serious matter; its expense is not so noticeable, however: where these bolts are cared for promptly and systematically as soon as they are discovered to be broken, the engine is seldom held out of service while renewals are being made; or if held, is held but a day or so, and not several days as in a renewal of flues.

Eliminating the cost, and viewing the matter of broken staybolts simply as a question of safety, the problem is one of the most serious confronting mechanical men today.

Our knowledge of what really takes place in a modern locomotive boiler when in service is indeed limited; and while we may have all formed theories, few of which are based on actual knowledge, as to the cause and remedy for broken staybolts, yet our theories remain but theories, and absolute knowledge is as yet an unknown quantity.

The generally accepted theory for broken staybolts is, that the breakage is due to the vibration of the bolt caused by the movement of the firebox as it expands and contracts with the variations in temperature; the bolt being subject at the same time to a tensile strain of anywhere from 1,000 to 3,000 lbs.

Granting this theory as correct, so far as it goes, what causes this vibration or movement? The heating and cooling of the firebox, you say? That is every time an engine is fired up the firebox due to the expansion of the sheets moves up and of course carries the staybolt with it, and when the fire is again drawn and the box cools off, it returns to its former position, thereby causing a vibration?

Let us look into this theory to see how far it is borne out by facts.

Repeated vibratory tests of staybolt iron made at the instance of both the railroad companies and the various manufacturers, prove, that a good long fibered piled iron will stand from 5,000 to 9,000 vibrations of one-sixteenth on either side of a common center; that is, that it will stand bending one-eighth of an inch from 5,000 to 9,000 times before breaking entirely, the iron being subject to a tensile strain of from 2,000 to 4,000 lbs. average as found, but cases have been frequently noted while making tests, where the staybolt was not screwed tight into the outer sheet, where over 200,000 vibrations were obtained. Taking the lowest figure, however, 5,000; if we only obtained a vibration every time the boiler was fired up and the fire again knocked, and, assuming that the engine is fired up once every day, we would get but 365 vibrations per year, and consequently it would take at least 14 years to break a staybolt. This we know to be absolutely wrong, as too many can bear witness.

The theory has been advanced that it is not necessary to knock a fire in order to produce a vibration, but that every change in steam pressure produces a corresponding change in temperature in the firebox sheets, this change causing an expansion and contraction sufficient to produce a vibration.

Let us look into this theory. Assuming that the sheets have approximately the same temperature as the firebox gases, which while the engine is in service, that is, on the road between terminals, will vary from 1,500 to 2,100 degs. F. After a sheet of iron as thin as a side sheet has been heated to 1,500 degs., the addition of 600 degs. will make no perceptible difference in its elongation or expansion.

If we take the water side as indicating the temperature of the side sheets, we would have a variation of but 48 degs. to correspond to a variation of 100 lbs. of steam pressure, and again, this would be offset by the expansion of the outer or wrapper sheets, assuming that these sheets expanded in the same direction. This would indicate that this theory of accounting for the vibration of staybolts is not tenable.

Again, we have what are commonly termed breaking zones; that is a certain part or parts of a boiler, or a certain location, where bolts break more frequently than at any other point. If the breakage of bolts is due solely to expansion, why do they break more frequently at one point than another? The expansion is equal!

The advocates of the expansion theory claim this is due to the greater rigidity of the outer sheets at these particular points. The cut shows what is usually termed the breaking zone in a side sheet. We will admit that rigidity of the outer sheet has some bearing on the subject, but that it is not the only factor is proved by the fact that the breakage of staybolts immediately above the mud ring, or behind expansion pads, does not occur as frequently as should obtain, were this the only cause.

The writer had occasion to examine many boilers which failed through various causes during the past eight years, and during the course of his examinations made a careful study of the staybolt feature, noting where possible, the average length of time the boiler was in service before the bolts began to show indications of fractures, also noting at what particular point of the bolt the fracture first started; that is, whether it started from the bottom, top, front or back.

As there has been quite a forward stride in boilers since 1900 we will only speak of those of later construction, say high pressure boilers built since 1903.

In examining some of these we found that the staybolts in the side and throat sheets invariably began to break from the bottom; thus showing an upward movement of the firebox, so that the bolt was in compression on its upper side and in tension on its lower side. This would go far to prove the case for the advocates of the expansion theory were it not for another curious fact noticed: viz., *all the belly brace bolts and belly braces began to break, or, in other words, showed fractures at the top*

or upper side, which would indicate that either the boiler moved up, or that the firebox moved down, at this particular point, either of which effects are manifestly impossible.

It was further noticed that although many of the boilers had been in service less than two years, that quite a number of staybolt renewals had been found necessary, and in one case noted where a boiler was cut apart for the purpose of thorough study and investigation, that although the boiler had not been in service five years, there were but few bolts in the entire installation, with the exception of the long radials, but what showed the beginning of a fracture. It is true that the fracture was slight in many cases, not extending more than from 1/16 in. to ⅛ in. into the bolt, but others were found where the fracture extended half way through. All the bolts were of a very high grade ductile iron, having a tensile strength of 50,000 lbs. per sq. in., and a high per cent. of elongation. This boiler had been running in what is termed a good water district, and is therefore a good example of the average life of a staybolt under favorable conditions to-day.

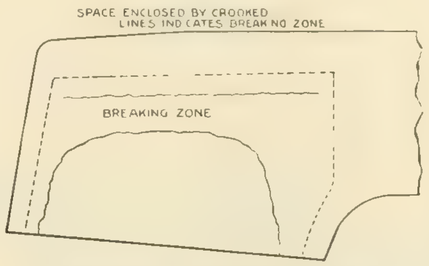
In a series of careful observations in the West in what is termed, and really is, a bad water district, it was found that the average life of staybolts in high pressure boilers, 200 lbs. and over, was considerably less than five years, and the question naturally arose, why? Why should there be a difference in the life of staybolts in a good and a bad water territory, especially when the failure of the bolts was due solely to breakage, and not to any pitting, corrosion, or other chemical action of the water referred to?

As stated in the beginning of this paper, the vibratory tests of staybolts showed that if a bolt was slightly loose in the outer sheet it would stand double and triple the number of vibrations that a tight bolt would.

We know that in applying staybolts we do not depend on the fit of the bolt to make it steam tight, but prevent leakage by hammering up the ends. This hammering simply upsets the outer end of the bolt, that is the end projecting through the sheet, and consequently if the bolt was screwed in loose enough to shake, the hammering or upseting will simply make it tight in the outside of the sheet and leave it loose on the inside, consequently it is free to vibrate in the hole, without leaking, and without putting the same vibratory strain on the bolt that would obtain were the bolt perfectly tight in the sheet through its entire thickness.

It is a known fact that where there is any slight leak about a boiler or any joint or seam that is not perfectly tight, any solids held in suspension in the water will invariably gravitate toward the leak or opening. In good water such sediment is soft and easily removed, and therefore the sediment collecting between a loose fitting staybolt and the sheet offers little resistance to vibration. In a bad water district, however, this sediment soon bakes hard as the iron itself, and therefore a staybolt which was originally slightly loose in the sheet, soon becomes absolutely rigid, and all vibratory stresses must of necessity be absorbed in the bolt. This has been proved to be the logical reason why staybolts have a seemingly shorter life in bad than in good water districts, as it was found where measures were taken to prevent incrustation, by participating the solids in the form of a sludge and removing this by blowing it out, the life of the staybolts was materially lengthened.

This brings us back to our subject matter, "The Care of Boilers," and what we can do by increased care or



STAYBOLT BREAKAGE ZONE.

change in present methods of caring for boilers, to prevent, or if not prevent, at least to decrease the breakage of staybolts.

Careful investigation has shown that where the bolt was originally screwed in straight, without any tension being applied in the installation, that as the firebox moves upward it puts the upper part of the bolt, where it is screwed into the outside sheet, in compression, at the same time the under side of the bolt is in tension. (In speaking of the upper and under side of the bolt, we refer in relation to the mud ring. That side of the bolt toward the mud ring being termed the under side.) As the firebox is returnd to its original position, either through contraction in cooling, or other causes,. the fiber in the lower half of the bolt, having been in a measure distorted even though but infinitessimally, is now slightly in compression, and this being repeated hundreds of times finally produces what may be termed a crystalization of the iron, but in the lower half of the bolt only, and eventually starting a fracture until at some time when the boiler is being abnormally forced, resulting in a high degree of expansion of the firebox sheets and a high tension on the staybolts due to the high pressure, complete rupture of the bolt takes place. This theory is proved by the fact at all staybolts which are but partially broken or fractured, show a short crystaline fracture where originally cracked, but if the bolt be now entirely broken the rest of the area of the bolt will show a long, fibrous fracture.

The only exception noted of bolts starting to break from the bottom, was in cases where the bolt was screwed into a double thickness in the outer sheet, or in some rigid corners, in these instances it was noticed that after the fracture had extended about half way through from the bottom, that the bolt began to show indications of fracture from the top, a fracture to the depth of about one-sixteenth to three thirty-secondths of an inch being noted, extending all the way round the unbroken or upper half of the semi-circumference of the bolt.

Therefore to decrease breakage where rigid bolts are used, we would suggest that while the bolt be made a tight fit in the inner or firebox sheets, it be left slightly loose in the outer or wrapper sheet, depending on the upsetting to make it steam tight. Further, that in bad water districts, means be adopted to prevent as far as possible, incrustation, so as to allow the bolt to retain a measure of flexibility in the outer sheet. That boilers be cooled off, or fires knocked only when absolutely necessary, and then slowly to prevent rapid and extreme changes in temperature, and last, when a bolt is found to be broken, remove it, to prevent an excessive strain on the neighboring bolts, thereby shortening their term of service.

Now a word in regard to a theory as to one of the causes of staybolt breakage.

It is hardly reasonable to suppose that a bolt which will stand from 5,000 to 9,000 vibrations in a vibrating machine will, if applied to a boiler, break after but 500 or 600 vibrations, and yet we must accept this as correct if we assume that the breakage is due to the vibrations and tensile strain (which is correct beyond a doubt) and that the vibrations are caused by the variations in temperature, causing an unequal expansion and contraction between the inner and outer sheets.

If this were the correct solution, why did we not have the same trouble with broken staybolts years ago that obtain to-day? We had the same expansion and generally shorter bolts, consequently the angle of vibration would have been greater and consequently more destructive to the iron fibers; each bolt sustained practically the same ten-

sile strain per square inch of bolt area, as, although the pressure was less the bolts were smaller and spaced farther apart. Do not understand me to say that we had no broken bolts in the olden days, because we had them, but we did not have as many in proportion to the number of bolts in a boiler as we have to-day.

There is but one other theory that we can advance that will explain the increased breakage of staybolts, and at the same time explain why the staybolts begin to break from the bottom, showing an upward movement of the firebox, while the throat sheet belly braces break from the top, showing an upward movement of the belly of the boiler; and that is, owing to the reduced steam space and increased throttle, dry pipes, and cylinder area, of the modern engine as compared to the old time engine, and also owing to the change in form of the boiler, especially the wide firebox type, there is a constant pulsation going on in the boiler when the engine is laboring hard, causing an upward and downward movement of the firebox and also an expansive and contractive movement of the cylindrical shell.

In order to understand this clearly, we know that as the firebox sheets become heated they naturally expand; as the mud ring prevents any downward movement the expansion is upward and endways, in fact the natural tendency of the firebox is to become larger. As steam is generated, however, it begins to press in on the firebox from all sides, at 200 lbs. per square inch, you can easily see what an enormous pressure is being brought to bear on the outside of the firebox. We therefore have the two forces acting one against the other, the heat expanding the firebox, while the steam pressure is trying to collapse or compress it.

It is virtually a battle of the giants. Is it not reasonable, therefore, to assume that as each cylinder volume of steam is withdrawn from the boiler that the pressure is momentarily relieved, not necessarily in pounds, but only in fractions of a pound, and that these fractions of a pound multiplied by the area of the firebox, relieve the compressive strain by just that amount and the firebox immediately responds to the momentary relief in pressure and moves in the direction of least resistance, which is up. The cylindrical part of the boiler which is in tension, momentarily contracts in its diameter; then as the heating surfaces again generate enough steam to replace the volume withdrawn the former conditions are restored and the firebox is again in a state of what may be termed expansive-compression, while the boiler is in a state of expansive-tension, the whole process or action of the boiler while the engine is laboring hard being almost similar to a man breathing.

It would naturally follow, therefore, that an increase in boiler capacity, and especially in steam space as compared to cylinder volume, would considerably lighten our costs of boiler maintenance and reduce our boiler failures.

The "General."

A handsome colored picture of a very famous old engine is being issued by the passenger department of the Nashville, Chattanooga & St. Louis Railway. The picture itself measures about 18 x 12 ins. and has a border of 3 ins. around that. It is of the old wood burning locomotive type, called the "General." It was the war engine of the Western & Atlantic Railroad. During the Civil War the "General" was captured at Big Shanty, now Kennesaw, Ga., on April 12th, 1862, by the "Andrews Raiders." It was recaptured near Ringgold, Ga., by G. A. Fuller, conductor, and Anthony Murphy, shop foreman of the railroad, assisted by Confederate soldiers and others, after an exciting chase of about ninety miles. The picture which is well worth framing will be sent to anyone for ten cents who applies to Mr. W. L. Danley, general passenger agent at Nashville, Tenn. The passenger department also give a full description of the stirring event. The engine is now on permanent exhibition in the Union Station at Chattanooga.

LOCOMOTIVE ON THE ICE. NOT NOW. BUT SOON.

Editorial Correspondence From Abroad

By

Angus Sinclair, D.E.

Every time that it has been my privilege to cross the Atlantic Ocean I have submitted notes on the voyage to the readers of RAILWAY AND LOCOMOTIVE ENGINEERING, and the letters have proved popular although they have contained little railway reading, so I venture to submit another epistle.

The passengers on a transatlantic steamer form a small colony in themselves that for a few days represent in a concentrated form a village or town.

When New York and all the United States were resounding with patriotic noise on July 4, intending voyagers were collecting on the decks, staterooms and cabins of the good steamer "Columbia" in New York, bound for Europe via Scotland. The usual stirring incidents of departure were to be seen. Hurry and bustle prevailed, with friends protracting the parting agonies. The final hugs and kisses were exchanged, watered in many cases by profuse tears. The missing baggage that had caused so much worry was found or given up in despair, visitors are chased ashore with difficulty, and then the big vessel draws slowly out of the dock amidst the plaudits of a multitude assembled on neighboring wharves.

What seemed an odd extra marked the departure of the "Columbia" from the Hudson River. Two lusty pipers walking on the deck with martial tread, sent forth the wailing notes of their noisy instruments as the vessel moved away from the dock, an incident that might have taken the minds of beholders away back into Scottish history when thousands of Highlanders were embarking for Canada from every harbor in the north of Scotland. They were frequently involuntary emigrants driven from their native glens through want and grim starvation that stalked on the ruin of industry which marked the close of the wars that gave Great Britain temporary prosperity at the beginning of the 19th century.

Then the unwilling voyagers left the land of their sires under the doleful pipes screaming "Lochaber No More," the most melancholy of tunes; and it was curious to hear the same tune resounding in New York Harbor to speed the parting guests bent in search of health, pleasure and enjoyment. Probably among the crowd were prosperous descendents of the Highlanders forced abroad three-quarters of a century ago,

"Like limbs from their country cast
bleeding and torn."

While on this subject, I cannot help reflecting upon the change of condition of modern sea going compared to the discomforts that prevailed when our grandparents were young. A celebrated emigrant ship plied between the east coast of Scotland fifty years ago that took many persons to carve fortunes in the back woods of Quebec and Ontario. The ship was a sailing vessel about 500 tons burden and carried about three hundred emigrants who were packed together without regard to health or decency. The voyage lasted from forty days to three months, forming a period of Inferno never to be forgotten in the longest lives.

This "Columbia" is a steel vessel built in 1902, and is reckoned of 8,292 tons burden, with engines of 9,000 horse power that push her through the water at an average speed of 16½ miles an hour, which takes the ship from New York to Glasgow in 7½ days. To perform this work about 170 tons of coal are burned per day, in six double ended and one single ended Scotch tubular boilers, providing 27,370 sq. ft. of heating surface and 869 sq. ft. of grate area. Natural draft is employed which does not make steam so rapidly as forced draft. The boiler pressure carried is 180 lbs. to the square inch.

There are two sets of triple expansion engines, which means that the steam enters the high pressure cylinder and on doing its work there passes in turn to the intermediate or low pressure cylinders, thence into the surface condenser where it is converted into water. Then it is pumped back into the boiler to perform the same cycle of force producing operations. Our locomotive friends who are accustomed to wrestling with scale and sheet burning impurities will understand that the water used in marine boilers is always soft, since the condensing keeps in use the same water from start to finish of the voyage. There is some loss due to leakage of glands and tubes which used to be made up by the admission of sea water into the boilers. That practice has now been abandoned and distilled sea water produced by a vaporator is used to make up for leakage losses.

For many years after steam boats were introduced, what was known as jet condensers were employed in which a spray of cold water was thrown into the vessel receiving the exhausted steam to produce a vacuum. To my young readers I might explain that the vacuum produced in a condenser sucks on the exhaust side of the low pressure piston, increasing the power about 12 lbs. per sq. in. of the piston area. As there are two low pressure

cylinders each 85 ins. diameter in these engines, the power derived from the vacuum is considerable.

Jet condensers, in which the water forming the steam was poured into the sea at each stroke, were abandoned many years ago in favor of surface condensers, which condense the exhaust steam by contact with small tubes kept cold by the circulation through them of sea water. That of course permits the feed water to be used over again indefinitely as described.

The principal advantage of using surface condensers was the providing of soft water for the boilers, which really effected material saving of heat, for sea water is a most undesirable liquid for steam making. It contains all the impurities that embarrass boiler users that draw water from land sources and a large admixture of salt rarely found on land.

When condensed water first came into use for marine boilers, it was found that the pure water had a deleterious effect upon the boiler sheets, causing serious corrosion that proved dangerous in some cases. The simple remedy of using salt water until the evaporation covered the sheets with a thin covering of scale, was found to stop corrosion.

The engines in this vessel are what is known as vertical inverted and there are two sets of them, one set for each propeller shaft. The cylinders stand in a line with the piston rods reaching through the bottom, which in stationery engines and locomotives is called the back head. The cylinders in these engines are 31.5, 51.5, and 85 ins. diameter by 54 ins. stroke.

Long ago when I first began to go down to the sea in steamships everything needing power was connected to the main engine, but nowadays the policy is to provide independent engines for all operations outside of driving the propellers. There are two air pumps driven by the main engines, but all other auxiliaries are separate, which includes two electric light engines with dynamos, 4 Weir pumps, 2 circulating pumps, 2 ballast pumps, 2 fire pumps, 2 fresh water pumps, 2 sanitary pumps, 2 boiler pumps, and one large refrigerating machine. I mention all these details to show the responsibility of the engineering department on a modern steamer.

On some ships that I have crossed on the refrigerator machine was said to be very troublesome, but Chief Engineer Denholm of this vessel says his refrigerating plant gives him no trouble, the only work called for being new packing for the pumps. It makes much difference who is in charge, just as it does with care of railway machinery.

This ship is not of a pretentious character like the "Mauretania" species, but she takes her load very comfortably across the ocean and puts them ashore refreshed and rested from the trip—a thing the rushing, exciting, five-day boats fail to accomplish.

A transatlantic steamer's load forms a community with as much population as a large village. There are on board this ship 215 saloon, 288 second cabin, 402 steerage passengers and 234 of a crew, making a total of 1,139 souls. The ladies are decidedly in the majority, the saloon having 138 women to 67 men, while the second cabin and the steerage have a greater proportion of the fair sex. Like all idlers the passengers on shipboard are very much occupied with means of amusing themselves and for promoting their personal comfort in every possible way. Captains on long voyages exert all their ingenuity to keep the sailors busy, hence happy. Work or amusement seems essential to keep away evil spirits, be it among mariners or passengers.

There is as much difference in the characteristics of passengers on shipboard as there are among communities ashore. The passengers on some steamers seem to go on board determined to clothe themselves in thick garments of reserve that act as non-conductors toward every move toward sociability on the part of people not duly presented and provided with testimonials of their snobility. It is different here. By the time the vessel was two days at sea all the passengers were talking together like old acquaintances, although the theme of conversation generally was where they came from or where they were going. It is known to chemistry that certain elements when mixed with others excite the affinities toward combination in a marked degree. We have here in the presence of David Chisholm of Kingussie-New York a human element very successful in putting other human elements into social intimacy. Mr. Chisholm is president of the Scottish Gaelic Society of New York and has been piper to the St. Andrews Society when the members met for social enjoyment, and he has the capacity of making friends at every turn. When he proceeded to make the people on the "Columbia" acquainted with each other the success of his efforts was immediate.

It is curious to watch how the tendency toward friendliness increases as we descend in the social scale, and a passenger steamer is a good place to note the phenomena. The people in the second cabin display manifestations of jollity that make the saloon people envious, and the steerage people seem as free from restraint as a crowd of school children.

The officers in charge of a passenger steamer do much to promote or depress the pleasures of the passengers. Those in charge of this boat are decidedly pleasant gentlemen. I have been under particular obligations for favors received

from Chief Engineer Denholm and Chief Steward White. In my intercourse with the former gentleman I received many interesting points concerning current marine engineering practice and gained the impression that Engineer Denholm was as well informed on his business as any man I had ever met.

A suggestion has come to me about ship surgeons. When the British Government first required all ships carrying emigrants to carry a surgeon, medical students with very limited knowledge of their business used to secure positions as ships' surgeons. One time an emigrant ship left Aberdeen and the surgeon was soon called upon to prescribe for drunken sailors and seasick emigrants. His childhood experience had led the surgeon to believe that epsom salts was the most certain remedy for all temporary maladies, so he dosed sailors and emigrants with the too laxative salts. The result was that the ship had to enter the nearest port until the effects of the physic wore off.

I sometimes think that the way medical men are turned out of some Scottish colleges robs the plough of creditable followers and puts boors mixing with refined people.

STATION AT WILLIMANTIC, CONN.

Writing of amusements, one of the most popular forms of pastime on shipboard is eating. The warm devotees of the dining room are about at 7 A. M. to fortify their stomachs with a cup of coffee and a biscuit. At 8 o'clock they are ready for breakfast, which is a substantial meal. About 10:30 they drink a cup of bouillon which keeps them comfortable till noon when lunch is ready, a meal that would pass for a good dinner on shore. Between 3 and 4 the stewards pass tea or coffee and biscuits, which are relished by the eaters to put their receptive organs ready for the bountiful dinner which comes at 6. Before going to bed they fortify their stomachs for the silent watches of the night by partaking of a Welsh rarebit or something equally as substantial. Very frequently those who have followed this regime for a week complain of loss of appetite and assert that, as a health giver, a sea voyage is not what it is cracked up to be. But whatever pretensions people make of enjoying themselves, a new and joyous light comes into their eyes when land appears.

Interesting Brochure.

The Record of Recent Construction No. 65, issued by the Baldwin Locomotive Works, of Philadelphia, is more than usually interesting. It is on Mallet articulated compound locomotives. It begins with a very instructive paper, reprinted by permission, which was read before the Engineers' Club of Philadelphia by Mr. Grafton Greenough in March, last. This paper traces the evolution of this class of engine from the earliest of double truck locomotives, through all its stages up to the present day. The Fairlie type as built in Great Britain, is shown, the Mason-Fairlie built in this country years ago, and the Fairlie engine built by the Baldwin Works for the Mexican Central. These are compared with a Baldwin double truck engine for the Sinnemahoning Valley Railway and an eight-wheel Mallet built in Switzerland. The distinction between the Fairlie and the Mallet forms are very clearly shown and the Baldwin design of Mallet for the Great Northern is illustrated generally and in detail.

There are also illustrations and descriptions of the various Baldwin Mallet engines built for a number of our leading railways in recent years. The paper not only gives the descriptive specifications of these interesting railway monsters, but shows a profile of the principal grades on which they work, but takes up the whole subject in a comprehensive way. There is a mass of useful, interesting and instructive matter contained between the covers of this little brochure. Not only are engines built in this country described, but those of Europe are in evidence, and a careful reader is more than repaid for the perusal of this epitome of American and European practice as relates to articulated compounds. There are a number of excellent line illustrations showing the details of articulated locomotives. The formula for finding the tractive effort of this class of engine is given, and the McCarroll air operated reversing mechanism is illustrated.

The discussion on Mr. Greenough's paper is contained in the "Record," consisting practically of an historical paper by Mr. S. M. Vauclain, which was illustrated by sketches on the blackboard, and which are here reproduced. Record No. 65 cannot fail to interest the general railroad man who is seeking information on the subject of Mallet Compounds and the technical man, the student and the engineer will be instructed and delighted. The Baldwin Locomotive Works will be happy to send a copy of this publication to anyone who sends them a request for one.

A man's worst enemy is his selfishness. It narrows and poisons his existence, and transforms him into a slave of himself. Selfishness is a narrow unhealthy cage where all our being languishes.—*Charles Wagner.*

Several Things.

In the correspondence department of our paper this month there is a very important letter on the subject of the derailment of tenders, which we commend to the attention of our readers. Those who have had similar experiences or who can throw any light on the subject are welcome to make use of our columns for that purpose.

The discussion of bank firing which has been brought out by a couple of letters to the editor, the second one printed this month, ought to interest firemen, engineers and others in the most efficient methods of "keeping her hot." The letters are well worth careful reading.

The care of boilers is a very important subject, and in this month's issue there is an article from Mr. F. P. Roesch, of the Southern Railway, in which he gives our readers the benefit of his experience, and his conclusions on the cause of staybolt breakage. We would be glad to have the opinion of others who, like our correspondent, have given the subject serious thought.

Our correspondence columns are open to the fair expression of opinion and argument, and while the editor is not responsible for any but his own views, Railway and Locomotive Engineering aims to promote the healthy discussion of railroad topics and to be the vehicle for disseminating useful information.

Strong and Efficient.

There is a most interesting and up-to-date shop situated in the environs of New York where they turn out an exceedingly practical machine for pipe threading, pipe cutting and nipple making. The builders call this their No. 2A machine, and a glance at it will soon reveal a number of good features which naturally appeal to the man or to the company who has much of this kind of work to do.

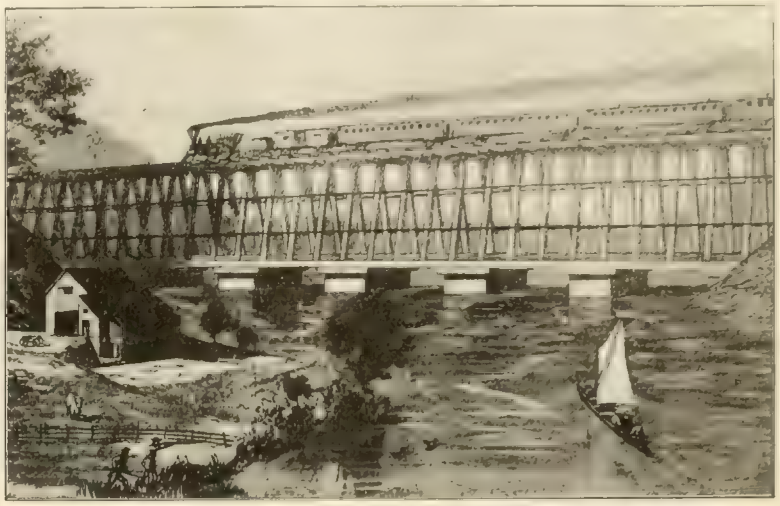
The machine is a strong and well designed piece of mechanism, and by that we mean that it will stand a lot of hard service and will do its work rapidly. Both these characteristics mean economy in shop operation. In describing this machine we may say that the arrangement of the chuck is such that pipe is gripped or loosened by the simple movement of a hand lever, without the necessity of stopping the rotating motion of the gripping chuck. It will be readily seen that there is a great saving of time by this improvement. The lever is handy, but is out of the way when not in use. The movement of the gripping jaws is applied through a system of sliding blocks and levers, which gives the required motion to the chuck jaws to grip any size pipe within the range, ¼ to 2 ins. It provides sufficient leverage to grip the pipe firmly by an easy motion of the lever. The operation of adjusting the jaws to grip the different sizes of pipe is very quickly made. All the gripping jaws center by one movement. When adjusted to any one size pipe the rotating motion of chuck need not be stopped until pipe of a different diameter is to be held. These jaws are of tool steel, and can be readily sharpened by grinding, without drawing the temper.

The cutting-head is arranged with the die-head on front, sliding in ways, which allows the die-head to be brought close to the gripping chuck. By this means short pieces of pipe can be threaded without the use of a nipple chuck. After the pipe has ben threaded and has to be moved for cutting off, the die-head is pushed to one side, allowing the pipe ample room to pass through the cutting-head without passing through the die-head and without causing injury of the chasers, by the pipe sliding over them. The cutting-off arrangement is very complete. There are two tools operated by a right and left hand-screw, bringing both tools in contact with the pipe at the same time. The adjustment of the tools is quick, accurate and simple. By this arrangement a pipe can be cut off in less than half the time than when one tool is used.

Two hardened steel V-jaws are used for steadying the pipe while being cut off. They are adjusted by a right and left hand-screw operated by a hand-wheel, automatically centering the pipe. When equipped with adjustable expanding die-

OLD PRINT OF HARBOR AND RAILROAD.

head, with interchangeable chasers, there is but one die-head with a number of sets of chasers, all fitting into the head to take a range of ¼ to 2 ins. The die head is arranged to slide in ways on the front of the cutting-head. It opens by means of a lever, releasing the pipe at once, when the required thread has been cut, without stopping or reversing the spindle of the machine.



OLD TIME WOODEN RAILROAD BRIDGE AND TRAIN

The cone pulley has four speeds, and with the changes of gearing gives eight changes of speeds in all; practically a speed for each size pipe ¼ to 2 ins. The gearing is changed by the movement of a lever. There are no loose gears; all remain on the machine. This gearing is all machine cut, and runs almost noiselessly. An automatic oil pump is provided to keep a constant flow of oil on the chasers and cutting-off tool.

When the machine is arranged to hold nipples, the jaws for gripping the pipe are removed, and replaced with jaws to hold nipples. There is a set of jaws for each size nipple, ¼ to 2 ins. They can be changed from one size to another quite readily, and they hold to thread either right or left hand. The threaded end of the nipple is placed in the jaws while chuck is revolving. The jaws are so arranged as to mash in pitch while in motion. The movement of the lever will cause the chuck to grip or loosen the nipple while revolving. The machine is altogether a very carefully designed piece of mechanism, and as we said before it will stand a lot of hard usage and do its work rapidly and well. Write for a circular on the subject to D. Saunder's Sons, Yonkers, N. Y., and they will give you full information of this very efficient machine.

No man is so foolish but he may give another good counsel sometimes, and no man so wise but he may easily err, if he takes no other counsel but his own; he that was taught only by himself had a fool for a master.—*Ben Johnson.*

B. of L. E. Union Meeting.

A most successful and probably the largest gathering of railroad engineers for many years was the opening of the annual meeting of the Canadian Divisions of the Brotherhood of Locomotive Engineers at Ottawa, Canada, on July 21-23. It is twenty two years since a similar gathering was held in that city, although a convention took place there in 1896. Visitors from all parts of Canada and the United States were present and enjoyed themselves to the utmost in the capital of the Dominion. The committee of arrangements, upon whose shoulders fell a heavy share of the work, was composed of Messrs. R. W. Botterell, C. Henry, P. Ray, J. Casey, A. R. Barr and Wm. Dewar.

Oilstones are obtained from many parts of the earth, but only in small quantities. On this account they are rarely mounted as grindstones, and workmen generally must content themselves with flat pieces, five or six inches long, and to prevent them from being broken, it is always best that they should be mounted on or in pieces of hardwood, and be provided with covers. Their flatness should be maintained, as they are generally more rapidly worn in the middle than at the ends. They can be readily ground on the side of a grindstone, or on a flat plate by the use of sand and water. The operation of sharpening a cutting tool on an oilstone is very simple. It is merely the formation of two flat facets, inclined to one another at a certain angle, their intersection being the cutting edge. Care, of course, being taken to keep the faces flat on the stone while rubbing, and in no case to form a separate facet on the edge, which is a sure method of destroying the efficiency of the tool. Oilstones are of a soft and porous quality, but the silica embedded in them will readily cut the hardest steel.

Chemical Fire Extinguisher.

The H. W. Johns-Manville Company, of 100 William street, New York, have recently put on the market what they call the Success Portable Fire Extinguisher. It is made of extra heavy Lake Superior cold rolled copper, securely riveted and reinforced by heavy shoulders of solder, every one of which is tested to withstand a pressure of 350 lbs. to the sq. in., this gives a factor of safety of 4. The joint where the cover is attached is usual- the weakest part, but the method of attaching the dome to the body of the shell is said to make that joint the strongest part in this extinguisher. The large wheel at the top of the machine is a convenience in opening and closing it, at the same time serving as a base on which to rest it when reversed, when in use, playing on a fire. The framework, or bottle holder, containing the supply of sulphuric acid, is cast brass and virtually indestructible. The bottle is of standard size

FIRE EXTINGUISHER.

and style for holding acid. It is obtainable anywhere in case of accidental fracture from any cause. The hose, tested to 400 lbs. to the sq. in., cannot be pulled off and is only detachable with a wrench, being joined to the body by a swivel ground joint. The nozzle is said to be absolutely non-corrosive.

No mechanical force is needed to put the apparatus in action; it is simply turned bottom up and the resultant mixture of sulphuric acid in the three gallons of water charged with bicarbonate of soda develops instantly force enough to throw a chemical stream of 50 ft. This chemical stream acts as a blanket and smothers fire which water cannot reach. By means of a lead stopper, fitting loosely, the flow of sulphuric acid is regulated and just the correct amount of gas generated at all times, making explosion impossible, so the company states. As this extinguisher neutralizes the acid before it leaves the machine, the stream, it is said, will not injure material with which it may come in contact. This extinguisher is included in the list of approved chemical extinguishers issued by the National Board of Fire Underwriters.

Spline Milling Machine.

Nearly everyone knows what a spline is. It is simply a slot, and the spline milling machine which is a new tool just put on the market by the Pratt & Whitney Company, of Hartford, Conn., does slot milling and is particularly adapted for cutting slots with closed ends. This has always been an expensive item and many designers who would have preferred to use the slot with closed ends have had to consider the time and cost involved and in many cases have had to content themselves with another form.

With the spline miller, slots having a depth of twice the diameter of the cutter and up to 4-in. centres and from 1/16 to 1 in. may be cut, and special fixtures for cutting circular slots may be had with the machine. The work-table, which is adjustable both in rate and amount of feed, travels between two cutter spindles which are adjustable in and out. These cutter spindles may be used simultaneously or independently, and are fed into the work automatically at any rate desired.

A so-called fish-tail cutter, with two, three or four lips, is used for milling slots, this form permitting the cutter to be fed into the work at each end, thus dispensing with the necessity of drilling a starting hole for closed end slotting. The tools or cutters are quite inexpensive to make, and sizes up to seven-sixteenths-inch cut are made double ended. The cutters are ground and held in the cutter spindle by a draw-in collet. For resharpening the cutters used in the machine, a fish-tail cutter grinding machine is recommended by the makers.

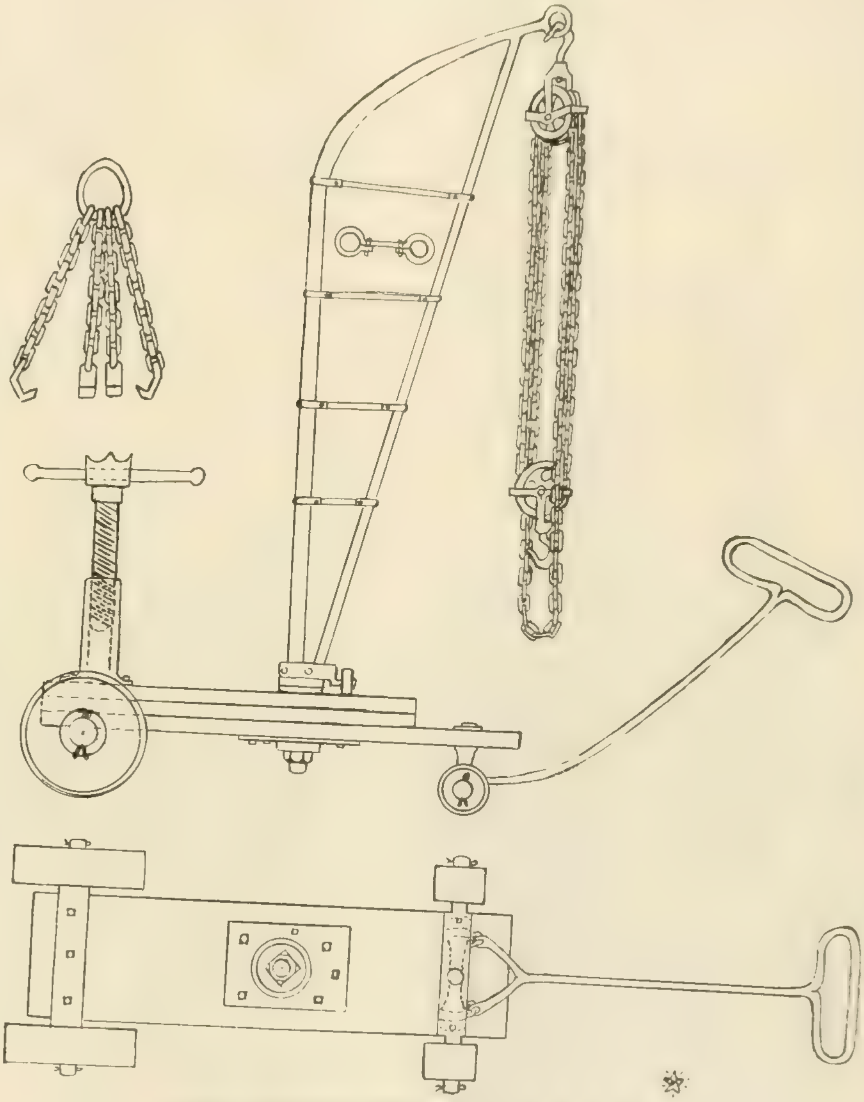
The Pratt & Whitney Co. have issued a beautifully illustrated descriptive catalogue of this spline milling machine and samples of its works shown give a comprehensive idea of the scope of its work. General foremen, master mechanics, superintendents of motive power and other mechanical department men will be greatly interested by a look through the pages of this catalogue, which is sent free on request to anyone who writes for one.

The American Locomotive Company have recently received an order for two compound consolidation, meter gauge locomotives for the American Railroad of Porto Rico. These engines have high pressure cylinders 14 in. in diameter, and low pressure cylinders 20 ins. in diameter. The stroke in both cases being 20 ins. The same company have also recently received an order for one 3 ft. 6 in. gauge Mogul Tank Locomotive, 2-6-0, T type, for the Imperial Taiwan Railway of Japan.

Useful Shop Derrick.

A very useful portable shop derrick, which is shown in our illustration, has been devised by Mr. W. Whitingham, the senior blacksmith of the Milwaukee shops of the Chicago & North Western Railway. The derrick or crane is mounted on a small lorry or truck and can be conveniently moved about the shop as circumstances require.

It is used for hoisting steam chests, main rods, etc., and will hold up considerable weight for the reason that the jack on one end of the little car is run under the buffer beam of an engine, tightened up and the little cart and crane can't move, and there is no slip to the derrick although it is mounted on wheels. This outfit is found useful by those who prefer not to use smoke stack cranes. The derrick is provided with suitable chain slings for taking hold of various articles and can be made use of in a lot of ways about railroad repair shops. Our illustration, made from a pen and ink sketch sent to us by our Agent Mr. Max Schuster, gives an excellent idea of the labor saving and handy arrangement.



SHOP DERRICK USED ON THE C. & N. W. RY.

The Safety Car Heating and Lighting Co., of New York, report having recently received orders for heating equipment from the Grand Trunk Railway and Grand Trunk Pacific as follows: 1 private car in service for the Grand Trunk; 12 coaches built at the railroad shops; 20 coaches built at the railroad shops for the Grand Trunk Pacific; 6 sleepers built by Barney & Smith Car Co.; 12 baggage built by Rhodes, Curry & Co.; 6 mail and express built by Canada Car Co.; 6 combination built by Canada Car Co., for the G. T. P.

The Whiting Foundry Equipment Company, of Harvey, Ill., have met with gratifying success in the issue of a neat little illustrated catalogue of their product. They tell us that the booklet was originally prepared for distribution as a souvenir at their exhibition booth at the Foundrymen's convention, held at Toronto, Canada, on June 8-12, 1908. The demand has led to a second edition for general circulation, being got out, covering as it does practically everything needed by up-to-date foundrymen in the way of mod-

ern equipment; it is sent out as a book of reference, for the use of those who require first class foundry equipment. The catalogue contains many illustrations and there are descriptions of the Whiting Cupola and of cupola accessories. Their charging machine is an interesting device. The car containing scrap iron, pig, etc., is tilted by power at such an angle that the contents are discharged into the cupola, the car being anchored to the platform for the time being. Their electric traveler when carrying a lifting magnet does a lot of heavy work about a foundry very expeditiously. They also have jib cranes of every type, ladles, tumblers, foundry turntables, core oven trucks and, in fact, anything connected with up-to-date foundry practice that you may think of. Write to them for one of their souvenir catalogues.

The L. S. Starrett Company of Athol, Mass., write us that they have opened a warehouse at 36 and 37 Upper Thames street, London, E. C., England, and will hereafter carry their fine mechanical tools, hack saws, steel tapes, etc., in stock at that place. The London branch will execute orders, render invoices and receive payments. The advantages of this arrangement to their British and Continental customers they say will be a saving of three or four weeks in being served. The goods will be brought freight paid to London; the bills will be rendered in pounds, shillings and pence, and payments are to be made in London. The company's catalogues, with sterling prices, and discount sheets, may be obtained at the above address. Their London branch is in charge of Mr. E. P. Barrus.

CONTENTS.

Railway and Locomotive Engineering

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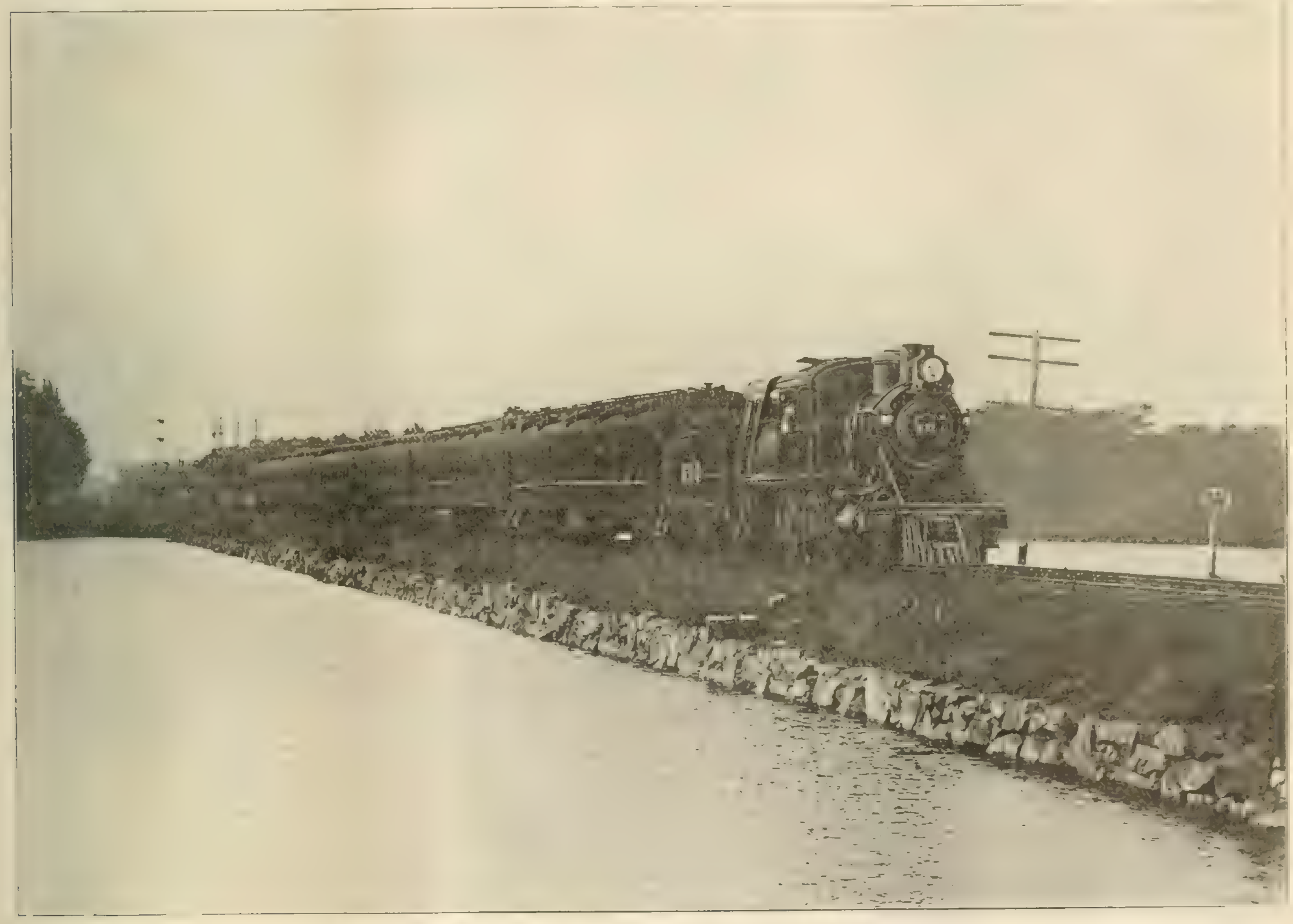
A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXI. | 114 Liberty Street, New York, September, 1908 | No. 9

Asbury Park Flyer

Our frontice picture this month shows the Asbury Park Flyer on the Central Railroad of New Jersey. The flyer has been "snapped" for RAILWAY AND LOCOMOTIVE ENGINEERING by our friend Mr. F. W. Blauvelt of New York. His work has often appeared in our pages and his ability to photograph moving trains is unquestioned. When the flyer was taken it was on the stone bordered embankment which carries the road across the picturesque little stretch of water known as Deal Lake, near Asbury Park.

This train makes the run from Jersey City to Asbury Park, a distance of 50 miles, in one minute less than the hour, and although no stops are booked for this train in the time table there are five slow-downs which cause the actual running time to be much faster than the figures themselves would indicate. The train consists of six coaches of the latest style and most up-to-date design. The engine is one of the C. R. R. of N. J. engines built at the Brooks works of the American Locomotive Company. The engine is a hard coal burner with wide firebox. The total heating surface is 2187 sq. ft. As an example of the extent of this area, suppose the coaches hauled by this engine to be 73 ft. long and the height 10 ft. That is the side resistance to wind which such a car would present without counting the trucks. The exposed side, as seen in the picture of the first three cars, would about equal 2190 sq. ft. or just three square feet more than the heating surface contained in the firebox and tubes of this engine.



ASBURY PARK FLYER CROSSING DEAL LAKE, C. R. R. OF N. J.

(Photographed by F. W. Blauvelt, New York.)

The cylinders are 19 x 26 ins. and the driving wheels are 69 ins. in diameter. The engine can exert a tractive effort of 24,276 lbs. This is equivalent to the weight it could draw up out of a well against the force of gravity, with suitably placed single cable and pulley. The engine itself weighs in working order

161,000 lbs., and out of this 120,000 lbs. are carried by the driving wheels.

The country traversed by the New York and Long Branch Railroad, which is one of the leased lines of the C. R. R. of N. J., is one of deversified interest. It attracts the literary man, the scientist and the lover of the historic. Atlantic Highlands, pier is the New Jersey terminus of the line of magnificent twin-screw steamers owned by the Central Railroad, and which ply between New York and the Highlands, is where the rail route to the pleasure resorts of the Jersey coast, or the "shore," as it is commonly named. Close to the Highlands is the low lying island called Sandy Hook, which is a government reservation. On this island are the proving grounds where modern high power ordnance is tested.

On the high bluff of the Highlands stands the Navesink Light station, a little to the south of Sandy Hook. This is probably the most important light on the whole coast, and many transatlantic travelers look for this light with eager eyes when returning from a trip abroad.

The station was established in 1828, the old style of illuminating apparatus, consisting of reflectors, was discontinued in 1841, and the station was then furnished with lighthouse lenses, such as are in use to-day, the apparatus being imported from France. It was the first of its kind in this country. One of these lenses was of the first order, and the other of the sec-

ELBERON STATION, C. R. R. OF N. J.

ond order, and they were a great improvement on the old apparatus. Owing to the delapidated condition of the towers they were rebuilt in 1862, and are those now in use. They consist of two brownstone structures 228 feet apart, S. by E. ¾ E. and S. by W. ¾ W., comnected by a brownstone dwelling. The north tower is octagonal and south tower square, the focal plane of the light on both towers being 246 feet above mean high water, giving a geographical range of 22¼ nautical miles.

In 1898 the first-order, fixed-white light in the south tower was extinguished and replaced by a second-order bivalve-lens of the new lightning light type, using an electric arc lamp, and giving a white flash every five seconds, the duration of the flashes being one-tenth of a second. At the same time the light in the north tower was also extinguished, but the lens was held in reserve for a while. The new electric light, on account of its brilliancy, caused much complaint among the residents of the neighborhood, and in order to correct this panels 14, 15 and 16 of the lantern were made opaque. The flash has been estimated at 90,000,000 candle power —in fact, the makers of the lens claimed 250,000,000 candles. In the first case the luminous range is estimated at 59 nautical miles for medium condition of weather on the ocean, but the elevation of the light remains as in the past—that is, 246 feet—and permits of a geographical range of 22¼ nautical miles.

Not far from Atlantic Highlands is Water Witch, made famous in Fennimore Cooper's story of that name. Many of the scenes and incidents which he describes are grouped around this charming spot. Navesink River, the mouth of which is practically behind Sandy Hook, is good fishing in the Indian meaning of the word and is a popular resort.

LIFEBOAT AND CREW, SEA BRIGHT, ON THE C. R. R. OF N. J.

One of the government life saving stations is situated at Sea Bright. Our illustration shows the rescue crew with their life boat prepared to push off into the surf. The ocean and lake coasts of the United States are dotted with stations of the Life-Saving Service, which is under control of the Treasury Department. There are in this branch a corps of inspectors, superintendents, station keepers and crews, extending over the entire coast line, also a board of experts on life-saving appliances selected from the Revenue Marine Service, the Army, the Life-Saving Service and some civilians. There are about 278 of these life-saving stations, 200 of which are on the Atlantic coast, 60 on the Great Lakes and 17 on the Pacific coast. The work done by the life-saving service is beyond all praise.

Near Long Branch is the famous boulevard along the ocean bluff, the highest elevation on the Atlantic coast from Maine to Florida. It is popular with automobilists and others who love to speed along a smooth, level road.

One of our illustrations shows the railway station at Elberon. This little town was where President Garfield was brought after he had been shot. Franklin Cottage at Elberon was selected in order to give the sufferer some respite from the intense heat at Washington. Elberon was also where President Grant transferred his official residence for a time during the hot weather.

Asbury Park has been called a World Mecca, a place where the people of a hundred countries foregather in the pursuit of recreation and health. Asbury Park can justly claim to be cosmopolitan, nevertheless there is a civic unity about the place. By way of affecting a uniform standard of decoration, all beach front buildings have been painted white, and to perfect the system of night illumination festoons of incandescent bulbs have been stretched along the boardwalk, and the

sea-front buildings have been outlined with electric lamps.

Sea Girt, the next door neighbor of Spring Lake, is famous less as a shore resort than as the place where every summer a "white city" springs up, and there may be seen jaunty soldier lads. At Sea Girt the National Guard of New Jersey make their annual encampment every summer, and there, too, is the headquarters of the International Rifle Association, where the crack shots from all over the world contest for marksmen's honors. The annual tournament brings many guests. From up and down the coast, and from the inland resorts, people come to visit the wonderful city of tents.

Memories of Robert Louis Stevenson make of Brielle something more than a mere summer resort, for here the author once lived for a time, thereby investing every scene of Glimmer-glass, of old ocean, of the twisting Manasquan, the shining white road, even the trees and the flowers with an atmosphere that the visitors to Brielle would not change for all the world.

Point Pleasant represents one of those instances where a place lives up to its name, and it is said that the real reason the Long Branch Railroad made Point Pleasant its terminus was because it was, metaphorically, the last word as to seashore resorts. There is less verdure to be seen along the shore than at many of the other resorts, but a short distance back from the beach there are dense woods. The beach has a boardwalk, at either end of which sand dunes, capped by little bunches of ribbon grass, flutter in the sea breeze northward to the Inlet, the Manasquan River rolls out against the ocean tide, and southward are the distant towers of Bay Head.

Gold Mill Robbery.

One of the stories which Mr. C. O. Eanes, chief special agent of the Missouri Pacific, told the St. Louis Railway Club a short time ago, when reading a paper on Train Robberies, is well worth reproducing. He said: "The train-robber, or rather the hold-up man, first started, in this country, in the extreme West. The stage hold-up was his first experience. This grew to be quite popular in the early '60's, when mining corporations commenced to build mills, and send in their products to the station, in stages, locked in the strong box of the stage. The West was the objective point for the loafer, and for the thief, and for the workingman who was thievingly inclined. The whole western country at that time was filled with men out of employment, men who had gone to the west seeking gold and not finding it, were looking for it in somebody else's pocket or strong box.

SHREWSBURY RIVER, SEA BRIGHT.

LOOKING FROM THE BRIDGE, DOWN THE RIVER AT SEA BRIGHT ON THE C. R. R. OF N. J.

"At first the robberies commenced with the product of these gold mills. I remember one experience I had in a stage coach robbery; there had been two stage coach robberies out of Maryville, Col., in which the money or gold belonging to the London Mining Co. had been taken from the strong box; it happened that each of these robberies had occurred at times when this milling company had sent in about $5,000 worth of gold to the bank. The output of gold and silver was generally sent in U. S. Government wagons, as the Government was buying the output of this mine, but occasionally they shipped some gold to the bank.

"These two robberies had occurred, when my attention was called to it by the president of the company, and I went out there to look into it. I found that there was one man only in the mill who knew anything about this shipment to the bank. This man was what they called the 'moulder.' He cast little ingots of gold from the [illegible] tons that came from the mill, and he was the only one who knew about the shipment. There were, however, four or five different men who attended him, bringing the products to him—gold and silver—into the room that he occupied a room about 10x15 [illegible]. He occupied this room alone, with the exception of these attendants who brought the gold to him.

"I made up my mind that this man was the one who had planned the robberies, if not executed them, because he knew just when the shipments were to be made. Therefore, I got one of my men—his name was Little, but he was very big—that is usually the way with names, you know. He stood about 6 ft. 4 ins. high, had long [illegible] and was born in Maine. He was very strong. I sent him up there to work as one of the attendants.

"I soon discovered that it was not the moulder, but two of the attendants who had planned and executed these two robberies, and they were only waiting for another chance, in order to get what they wanted and get out of the country. My man, of course, was taken into the scheme, and I waited until the proper night came. The information was given by the moulder casually, not intentionally, to his assistants that a shipment was to be made to the bank.

"The three men went about ten miles from Maryville one night—it was a moonlight night—and I happened to be there with the sheriff and two deputies. We took the passengers out of the stage coach and let them

NORWOOD PARK AT LONG BRANCH

wait until we came back, while we went out with an empty strong box, of course, to be robbed.

"The funny part of it was that—I can hardly explain why, or how it happened—when we came to the designated point, we could see these three men rise out of the sage brush with the shot-guns which they had and come towards the stage coach. My man was slightly in the rear, in the middle. We were to wait until they held up the stage coach; my man was to come around to one side, and we were to fill them full of holes. That was the plan. My man, however, who had associated with them, felt that they ought to be punished differently—that is, punished by the Government and by law. Therefore, when they got pretty near the stage coach, and we could see them plainly, for they were silhouetted against the moonlight. There was my man behind the rest of them, and he grabbed the two of them by the neck and bumped their heads together. Well, they did not know much of anything until we got them back to Marysville. Those men were sent to the penitentiary for twenty-five years, at Canon City.

"Stage robberies continued to occur very fast, until finally they had reached the Middle West, and train robberies were the order of the day. Trains were held up at first by large gangs of men, men who did not deserve any of the leniency shown them, because any train robber is a murderer at heart, and must be in order to choose train robbery for his avocation.

"I believe that the advancement of train robbery was due, at least nine-tenths of it, to the advertisement that train robbers got in the newspapers. When a train was robbed, that is, when a train robbery was successfully carried out, the whole front page of the newspapers was covered. But when train robbers were caught and punished there was a little item, quite short, in the middle of the paper, somewhere. That resulted only in one way, and it was in the elevation of train robbery to the place of honor.

"Then, following that, came the yellow backed literature that was sold by newsboys on the trains. Nothing took so well as a train robbery—'Seven Buckets of Blood, or Diamond Dick the Train Robber,' that attracted people in the trains. Sometimes when it came to be known that there was little care taken of the trains, and little done to stop train robberies, or to prevent hold-ups, one man managed successfully to make a splendid train robbery. We had one out there on the Frisco, only one man, and he is a telegraph operator. This man succeeded in holding up a train. It is true that one of our St. Louis detectives, when he looked at that one man, saw seven men, but it was only one man. As a rule, however, train robberies were committed by gangs.

"The Missouri Pacific Co., which I represent at the present time, has been unusually free from this class of crime, and I think that this is due to the position taken by the officers of the company, their willingness to spend money and to ferret out the criminals, and the fact that they stand back of the officers until the criminals are punished."

Practical, Good Sense, Talk.

The address of Mr. Robert Quayle, superintendent of motive power of the Chicago & Northwestern Railway, was a plain practical talk to practical men, at the recent convention of the International Railway General Foremen's Association. Space does not permit us to give Mr. Quayle's admirable address in full, which will be published later on in the proceedings of the association. Among other things, Mr. Quayle said:

"The first essential toward the success of a man is for a man to think, and think clear down through whatever you have. The man who takes up air brake mechanism must first begin with the atmosphere—the component parts of the atmosphere; he must understand what the pressure of the atmosphere is. He must see it through the engineer's valve—through the triple valve, and so on; he must take a little wire and trace it from the time it is received into the pump. He must know what the offices of the different pieces of mechanism are and have an intelligent idea so that if anything goes wrong he knows probably by the weakness of the different functions of the air brake where to look for the trouble, and if he does not locate it there he knows the next point to go to, where the second greatest number of failures occur, and this man is equipped to accomplish something in a moment's time. So it ought to be with you and so it ought to be with me. You are filling positions because of your alertness—because of your intelligence and because you have shown to the man who in position is your superior—you have shown to him clearly that you have something in you that the other fellow did not have and that quality that is in you he has discovered, and he says, 'There is the man we want to promote, because he has qualifications that will make us a man that will be efficient, and he has the ability that will help to raise other men up to a higher efficiency.' If that be true, you men as superintendents of shops or general foremen ought to get about you men of intelligence—men of such rare qualities and ability who will see things and be able to eliminate and cut out all the unnecessary movements that are being made and get down to the actual movements that are necessary to accomplish a certain thing in a certain time. We should make every movement count.

"You see a man in your shop take a certain piece of work and it has to go from the machine shop to the tin shop and the man has to travel several hundred feet and back. What is the matter with us having a little machine and doing all that cross-head work right where the cross-head is being fitted and save all this going back and forth? These are things that count. Where you have a shop, as some of you may have, and have charge of two or three thousand men, you can readily see that the movements of these men amount to a good deal. Your office is to know that these men are not making any more movements than is absolutely necessary. It means labor to walk back and forth—it means effort on the part of the men; whereas, instead of putting that effort into useless movements, put it into things that count. If you have been advanced to a position because of your intelligence, how much of that intelligence are you imparting to the under fellow?

"You have these men about you and you should ask them why they are doing such things so and so. If they are turning off a piston rod, ask them why they do not grind it. Is it possible that in thirty years there has been no improvement in this line? Get these men before you. Do not drive it into them in a rough manner, but in an intelligent way, and they won't feel that you are clubbing them. A club over your head don't do you any good and if you have a man who has to have a club over his head, get rid of him. When a man feels that you are driving him, he gets discouraged and don't care; you drive away his usefulness and his interest, and when his interest is gone he is no good to himself or anybody else. Encouragement ought to be the shop motto. Get every man to do the best he can and to lift himself up to the highest within the limits of his ability.

"I take great pleasure in the thought that in so far as the motive power is concerned, it is not I but the men who are associated with me, are working with me and assisting me in every way possible to make it a success, and they are helping themselves. If any of you think that the superintendent of motive power is the only fellow, get it out of your heads. He is only a little factor and they get him on their shoulders and they pass him along and keep carrying him along. It is a continual delight to me. Why should not I get around these men and help to lift them up—make them more useful to themselves and their fellowmen? Would I be a man if I did not? If that is true of the superintendents of motive power, isn't it true of you? The same

kind of flesh, the same kind of sentiment, the same kind of heart power, and the same kind of everything that goes to make up a human being is in you and in me. Let us use it to the very best possible advantage for the other man, and when we are doing that the other man uses his powers to lift you up."

Tank Engine for the Rahway Valley.

The Baldwin Locomotive Works have recently delivered to the Rahway Valley Railroad Company a four-coupled tank locomotive which is shown in our illustration. This engine is in passenger service on a short line having grades of 2 per cent. and 17 deg. curves. As it was desired to run in either direction without turning, the 2-4-4 wheel arrangement was adopted. The four-wheeled rear truck improves the riding qualities, and permits the use of ample fuel and water capacity without placing an excessive amount of weight on the rear wheels.

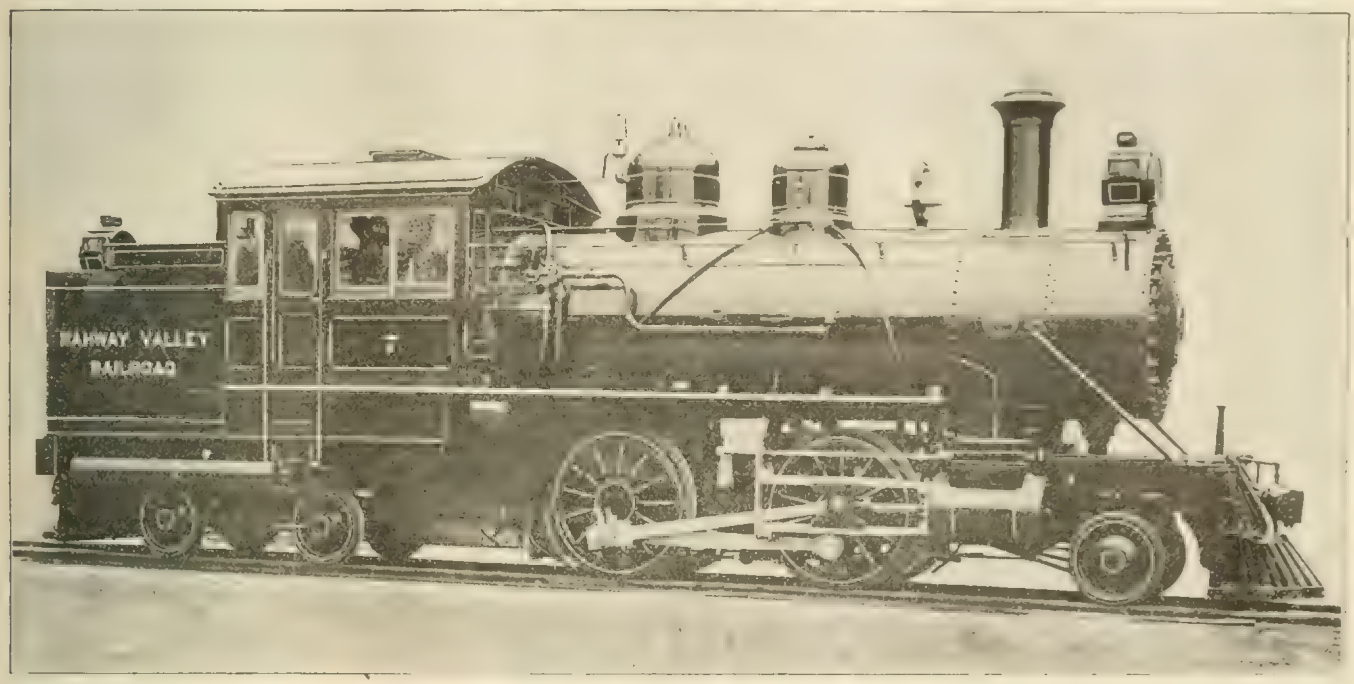
The cylinders are 17 x 24 simple and the driving wheels are 56 ins. in diameter and with a steam pressure of 180 lbs. The engine can exert a maximum tractive force of 18,950 lbs. The two-wheeled leading truck of this locomotive is equalized with the driving-wheels by two equalizing beams, placed one on each side of the center line, and fulcrumed under the cylinder saddle. The front truck is thus virtually side-bearing. The rear truck is center-bearing, and is of the usual type, with cast steel swing bolster and wrought iron frame and pedestals. The locomotive is thus supported like a three-legged stool, and at the same time curves equally well when running in either direction. All the truck wheels are of solid rolled and forged steel, and were supplied by the Standard Steel Works Company of Philadelphia.

The main frames are of cast steel, while the front rails are of wrought iron, in the form of slabs, and are bolted to the main frames back of the rear driving pedestals. A cast steel filling piece bolted in between the upper and lower rails of the main frames, serves as a combined equalizing beam fulcrum and brake hanger support. The guides are of forged steel of the alligator type, and the crossheads are of cast steel. The slide valves are balanced and are driven by a simple form of Stephenson link motion, having the eccentrics placed on the second driving axle.

The boiler is straight top type, with a deep firebox arranged for soft coal burning. The box is placed between the rear frames and is supported by expansion bearers. A brick arch is provided and it is supported on studs. The boiler shell is 64 ins. in diameter, and the heating surface is liberal for a locomotive of this class. There are 223 steel tubes in the boiler each 11 ft. 7 ins. long, 2 ins. in diameter, and these provide 1,343 sq. ft. of heating surface. The firebox contributes 152 sq. ft., making a total heating surface of 1,495 sq. ft. The grate area is 18.2 sq. ft. and this gives a proportion of 1 sq. ft. of grate area to every 82 sq. ft. of heating surface.

The tank has a water bottom with a sloping floor for fuel space. The cab is roomy and comfortable, and is arranged with due regard for the convenience of the enginemen. This is a compact and well designed locomotive, simple in construction, with all parts readily accessible, and well adapted to the service to be performed. Our halftone shows the principal features of the design, while the dimensions are given in the table which follows:

Valve, Balanced Slide.
Boiler.—Thickness of [illegible] in., working pressure, 180 lbs. [illegible]
Firebox.—Material, steel, [illegible] 11/16 ins.; width, [illegible] ins.; depth, front, [illegible]; depth, back, 83 [illegible] ins.; thickness of sheets, sides, 5/16 in.; thickness of sheets, back, 5/16 ins.; thickness of sheets, crown, [illegible]; thickness of sheets, tube, [illegible] in.
Water Space.—Front, 4 ins.; sides, [illegible]; back, 3 ins.
Tubes.—Wire gauge, No. 12.
Driving Wheels.—Diameter, outside, 56 ins.; journals, [illegible] ins.
Engine Truck Wheels.—Diameter, front, 30 ins.; journals, 5x8 ins.; diameter, back, 30 ins.; journals, 5½x10 ins.
Wheel Base.—Driving, 7 ft.; total engine, 31 ft. 4 ins.
Weight.—On driving wheels, estimated, [illegible] lbs.; total engine, estimated, 135,[illegible] lbs.
Tender.—Tank capacity, 2,500 gals.; fuel capacity, 3 tons.
Service.—Passenger.



2-4-4 TANK ENGINE FOR THE RAHWAY VALLEY RAILROAD

H. F. Dankel, Gen'l Manager. Baldwin Locomotive Works, Builders.

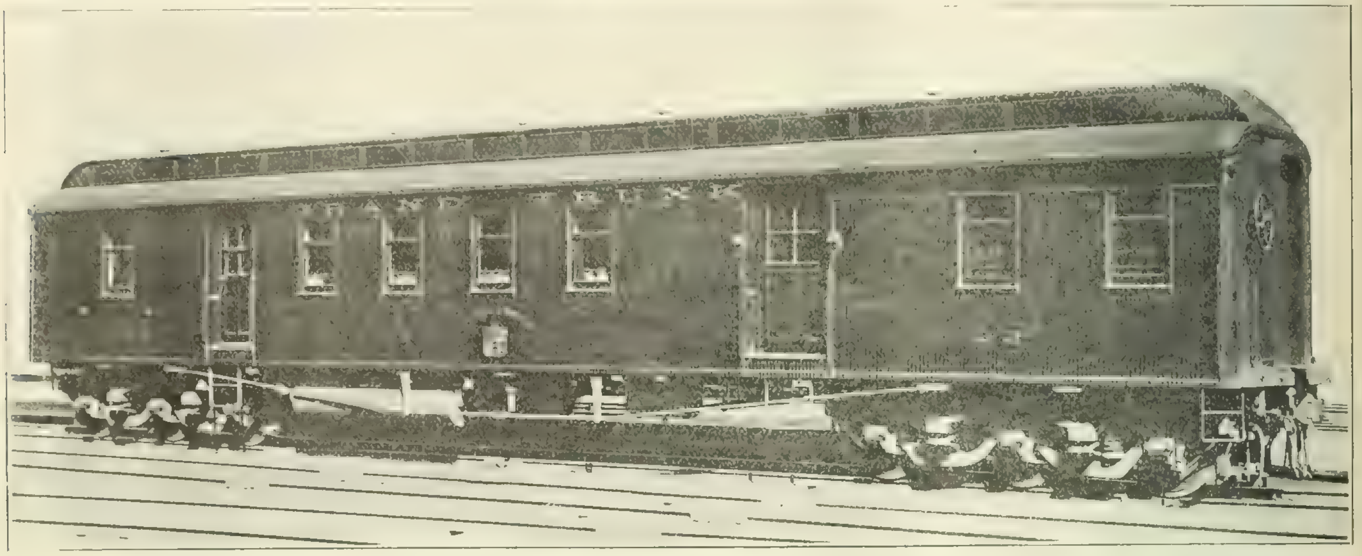
The Car Ferry, owned by the Grand Trunk Railway and running between Coburg and Charlotte, was built by the Canadian Ship Building Company of Toronto, Ont. In the August issue of RAILWAY AND LOCOMOTIVE ENGINEERING the Polson Iron Works was incorrectly mentioned as the builders.

I knew a wise man who had it for a byword when he saw men hasten to a conclusion: "Stay a little, that we may make an end the sooner."—*Bacon.*

New Canadian Mail Cars.

The car department of the Grand Trunk Railway System recently turned out and have put into service between Montreal and Toronto, two fine new mail cars. They are 60 ft. long inside measurement, equipped with improved single mantle gas lamps made by the Safety Car Heating and Lighting Co., of New York. This inverted single mantle lamp is used in conjunction with the standard Pintsch lighting equipment and is very popular in the Dominion, there being quite a number of them used on the railways in Canada.

The Grand Trunk mail cars are, of course, supplied with all modern fittings. The interior arrangements are in accord with the plans furnished to the government by the railway company. The body of the cars are painted in the Grand Trunk standard color and bear the Canadian coat-of-arms on both sides as required by the Railway Mail Service. The cars are set up on two six-wheel trucks with 38-in. steel tired wheels. The cars have Westinghouse quick-action air brakes and air signal, automatic coupler buffing devices, straight steam heating, etc. Our illustration shows the exterior of one of these cars. They are of the non-vestibule or no platform type and in the Grand Trunk service they will always be in the forward part of the train. They were built at the Point St. Charles Shops of the railway.

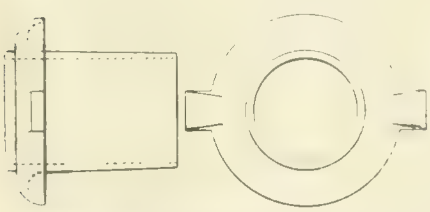


NEW GRAND TRUNK RAILWAY MAIL SERVICE CAR.

Emergency Thimble.

What is called an emergency thimble for locomotive and other boiler flues has been devised and patented recently by Mr. Max Toltz, of the Superheating and Engineering Company. The object of his invention is to provide a thimble which may be readily inserted into, or withdrawn from, the end of the flue, when leakage is caused or threatened by reason of the burning away of the exposed parts. The thimble covers the exposed end of a flue and so seals the joint on the inside of the flue sheet.

Our illustration represents the flue sheet of a tubular boiler, with a flue secured in place in the usual way. In ordinary practice the projecting end of the flue which is rolled over on the outside of the flue-sheet forms a head, while just inside the flue-sheet, the flue when expanded, forms an annular depression which seals the joint between the flue and flue-sheet on the inside.

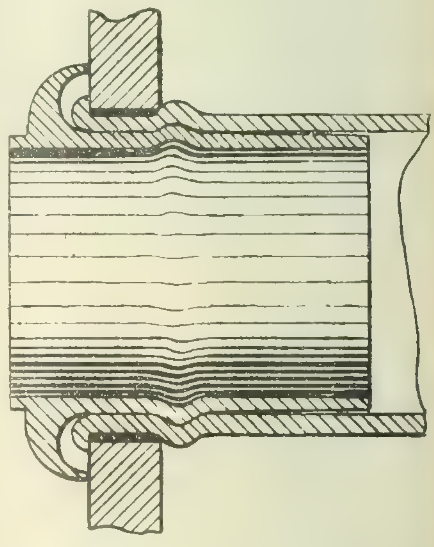


EMERGENCY THIMBLE FOR FLUES.

The "emergency" consists of a short piece of tube made to fit snugly into the flue and externally tapered towards its inner end, to facilitate insertion into the flue and for removal therefrom. Near to, but not quite at its outer end, it is formed with a rearwardly cupped circular flange large enough to extend beyond the bead and touch the outside of the flue-sheet, thereby covering the exposed end of the flue and protecting it and the adjacent portion of the flue-sheet. To enable the thimble to be driven into the flue without injury to the bead, the tubular portion of the thimble is extended beyond the flange so as to form a projection in line with the tube and upon this projection the hammer blows are received.

The thimble is preferably a drop forging of steel or malleable iron so that when driven into the flue, it may be rolled or expanded just inside the flue sheet. By rolling it into the flue, and thereby expanding the flue as well, the joint between the flue and flue-sheet on the inside is sealed.

To facilitate the withdrawal of the thimble from the flue, the thimble is made with laterally projecting lugs, one at each side. By driving a wedge-shaped tool between the flue and the lugs, the thimble can be forced out of the flue. By the use of the emergency thimble, when injury takes place, or leakage is threatened at the joint between the flue and flue-sheet, it may be stopped or patched up as it were, without removing or replacing the flue, until such time as regular repairs can be made. The idea in the emergency thimble is to stop a leak and yet keep the boiler-tube in service for the time being. It is, of course, not designed to be a permanent fixture, but is useful for what it is intended, an emergency.



EMERGENCY THIMBLE IN PLACE.

General Correspondence

Bank Firing of Locomotives.

Editor:

Down here in the South they tell a story of an old darkey who was sent to jail for a minor offense and was advised by his friends to employ an attorney to defend him. The lawyer visited his client in jail and the following conversation ensued.

"Well, Uncle Mose, what are you in here for? What did you do this time?"

"Nothin', boss, 'clare to goodness, boss, I ain' done nothin' at all."

"Why, Uncle Mose, you certainly must have done something, they cannot put you in jail for nothing."

"Cain't, hey, cain't put me in jail fo' nothin'?"

"Why no, certainly not."

"Well, boss, dah may be, I doan' wan'ah 'spute yo' all, but I'se shore here."

Quoting from the article on "Bank Fireing" by Mr. Roberts in the August number of RAILWAY AND LOCOMOTIVE ENGINEERING, "bank firing gives results in every way inferior to the level firing; it necessitates the use of more fuel, causes the emission of more smoke, and does not maintain the steam pressure as constant as the level fire."

To paraphrase his remarks. You cannot maintain a steady pressure, you cannot prevent the emission of black smoke, and you burn more coal in the bank than with the level method of fireing.

I can only say with the Southern darkey: "Well, boss, dah may be, I doan wan'ah 'spute yo' all, but we shore does it."

Mr. Roberts article is good. It shows considerable thought and study, and no doubt, there is no question but what he is exactly right as applied to the type of locomotive he comes in contact with, and to the particular circumstances under which they operate. We must not forget, however, that firing methods, like front end standards, are subject to change to suit local conditions, and likewise, we can not advance a purely local success as a standard for universal adoption.

Bank firing is practiced very successfully in this section, but only on engines whose grates have a decided downward slope from the fire door to the flue sheet. The level method has frequently been tried with this style of grate, but at this end of about fifty miles, involuntarily, resolved itself into the bank method, as the natural action of the draft aided by the vibration of the engine had such a tendency to draw the coal forward, that the fire soon became excessively heavy at the flue sheet. It was then necessary to simply place the coal on a sloping bank at the rear of the firebox, allowing it to feed forward as the coal ahead was consumed exactly on the same principle as obtains in all successful mechanically fired stationery plants.

In the fourth paragraph Mr. Roberts uses the very best argument in favor of "bank firing" that can be advanced if we simply substitute for "deficiencies" efficiency, and omit the word "not" in the second sentence; as in bank firing when correctly practiced ideal conditions for the generation of steam certainly prevail, providing always that the grates have a sufficient slope to allow the fire to feed forward naturally.

MAKING A GOOD START.

Correct bank firing does not consist of "hit or miss" methods, or of building up a mountain of green coal directly on the grates any old place so long as it is in the back end of the box, but involves considerable care and some skill in its first preparation. It

is necessary to begin with a glowing incandescent bed of fire upon which the bank is built, and thereafter care must be exercised to see that the glowing heat under the bank is maintained. This has the effect of slowly distilling from the green coal the volatile gases, which in their passage over the bright fire ahead are at once heated to the combining temperature and converted into CO_2 instead of passing off as smoke.

All exponents of economical, and of course comparatively smokeless firing advocate maintaining one half of the fire bright always, by applying the fresh charges of coal to alternate sides, leaving the bright side of the fire to consume the gases distilled from each fresh charge. In bank firing this condition always obtains, with the added advantage that fully three fourths of the fire is kept bright, and no part is ever materially lowered in temperature even momentarily, by the fresh charge of coal, as must obtain with the level system of fireing.

"Consistency, thou art a jewel." Mr. Roberts declaims against restricting the grate area with a bank fire in one sentence and in the next advocates with equal fervency the bricking up of the grate. He also claims in one sentence the carbon mon-oxide distilled from the bank at the rear of the firebox, will not have time to be converted into CO_2, between the bank and the flue sheet, i. e. in the full length of the firebox, on account of short flameway. In the name of Dr. Sinclair who has forgotten as much about combustion in a locomotive firebox as half of us ever knew, what course should these gases pursue to obtain greater flameway?

The point in regard to the separation of the air entering the firebox into three distinct strata will not be accepted by the advocates of bank firing until further proof is furnished. "We are all from Missouri." And why a column of air flowing into a firebox by the induced action of the draft should take a course contrary to all natural laws, simply because it meets with a bank of coal partially restricting its entrance, will also require elucidation. The burden of proof rests with the opposition as the advocate of bank firing, Mr. Donaldson, in RAILWAY AND LOCOMOTIVE ENGINEERING in June, first made the assertion that this air was sprayed and mixed with the gases. Mr. Roberts simply denies this. If it does not, *why* don't it? We also offer strong objections to bank firing being classed as of the "hit or miss method." Bank firing correctly practiced requires equally as much judgment as the level system, and is not performed any old way.

In conclusion, we must take especially strong exception to the concluding paragraphs in Mr. Roberts' article, relative to coersive measures being necessary to induce firemen to strive for high efficiency. According to the experience of the writer, dating back several years and extending over the major portion of the U. S., this charge is absolutely and entirely wrong. Further, the writer will venture the assertion that in no other calling, either in railway or any other service, can there be shown as high a percentage of the total number employed, who are striving with equal fidelity to improve themselves in general knowledge relating to their avocation, many of them striving under the most adverse conditions and trying circumstances, yet they go ahead undiscouraged until by trial and observation they learn to mix brain with CO_2 in the process of combustion and so lighten their labors.

VIEW FROM CAB OF BALDWIN ENGINE NO. 1, SAN RAFAEL & ATLIXCO RAILROAD.

Bank firing is one of these results, and if upon fair trial it is found to lighten the labors of the fireman, without a corresponding loss in fuel and locomotive efficiency, it certainly should receive the endorsement of the motive power officials. What the fireman needs is help and encouragement, and if this be rendered fully and freely, coersion will be found unnecessary.

F. P. ROESCH.

Spencer, N. C.

Bank Fireing vs. Level Firing.

Editor:

Having read with interest the articles in your June and August numbers of RAILWAY AND LOCOMOTIVE ENGINEERING regarding the burning of bituminous coal in locomotives, I would say both parties have expressed their views in a very able manner.

I must confess, however, after having had considerable experience in burning difficult grades of bituminous coal in both narrow and wide fireboxes, I have been very forcibly convinced that the object in designing the wide firebox was other than a receptacle for the storage of coal. While I do not claim this bank firing cannot be successfully carried out under certain conditions, but speaking from an economical standpoint the level or spreading system is superior for the following reasons:

First, that it permits of higher as well as a more uniform temperature being carried at all times, which is the ideal purpose for which this wide firebox was designed.

Second, that it permits of a more perfect mixture of the oxygen of the air with the fuel gases, thereby ensuring their more perfect burning.

Third, that it permits of the firing being done with the scoop and doing away with the necessity of using other firing tools, such as hooks and others, which is one of the most wasteful habits practiced at the present time in different localities.

Fourth, that it permits of the fire being kept cleaner at all times and under all conditions.

It has been demonstrated that in order to properly burn these gases as they are liberated or roasted out of the coal the firebox temperature must not be lower than 1,800 degs. The exact temperature is not so important for a fireman to know as the effect of a low temperature.

Now, if air is admitted in large stream as would be the case where this bank is in rear end and light forward thus keeping the temperature below 1,800 degs. and possibly about 900 degs. at which the gases pass from the fresh coal or bank, the most valuable heat producing elements in the coal are roasted out and are lost owing to their not having sufficient time to combine with the oxygen of the air in passing over this fraction of exposed firebox surface to burn and produce heat. If, however, the coal had been evenly spread over the fire so as to make the supply of air containing the oxygen come as evenly through all parts of the fire, it would be burning fiercely all over the surface and thus would be producing a greater amount of heat and therefore causing the expansion and contraction to be more uniform, which is a very important factor in guarding against choking flues, broken bolts and cracked sheets, as this temperature would be heating the air and gases to a higher temperature at the instant they passed above the fire to where the gases were ready to be consumed so that a more perfect combustion would have taken place.

Here is where the brick arch assists in

the economy of fuel, for it not only retards the flow of air and gases toward the flues, but it assists in more intimately mixing them, while they are held in a higher temperature by the glowing fire on one side and the hot arch on the other. The flues can in a lesser degree mix the air and gases, but over in the flues the temperature is reduced below the igniting point, as the water surrounding these flues has a temperature of about 380 degs. when carrying 180 lbs. boiler pressure, therefore the cooling takes place the instant they enter the flues. The temperature in the centre of the firebox properly drafted and properly fired, is usually about 2,000 degs. We can presume that the temperature of the brick arch in company with the air that has come through the grates and fire there is a better chance for the oxygen of the heated air to combine with all the gases and produce a full amount of heat, thus more perfect combustion is accomplished.

PETER DENEEF,
Instructor of firemen, E. & C Div.
Pennsylvania Railroad.

Elmira.

For Meritorious Service.

Editor:

We have had for some years in operation on this road the Brown System of Discipline, originating, as you know, with Mr. George Brown of the Fall Brook Railroad, which provides for a debit and credit record of practically all transportation employees on the line. I have thought for some time that good results could be obtained and a spirit of emulation cultivated by some sort of recognition for good service performed, and for this reason we inaugurated the system of issuing passes to employees for meritorious service, with a view of extending same later on when the details could be worked out.

In the issuance of passes that have been sent out we took into consideration the length of time the employee had been in service, those who had clear record for the past year and who had also received commendation for unusual interest manifested in the company's welfare in one way or another. The pass issued was a System pass, good for the employee and his wife, and stamped on the face "For Meritorious Service." The classes of employees included were conductors, engineers and station agents.

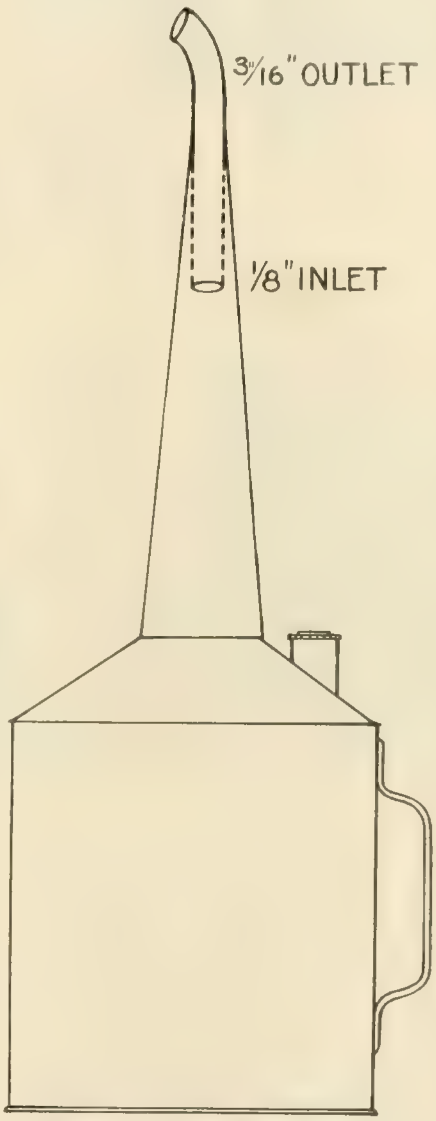
E. E. CALVIN,
Vice President and Gen. Mgr.
Southern Pacific Co.

San Francisco, Cal.

Non-Clogging Oil Can

Editor:

I am sending a rough sketch of my "Profanity Preventative." Where is the engineer who at some time has not been driven to cuss words by having his oil can plug up at the time it was most needed. This little device is a piece of 3/16 in. tubing reduced to ⅛ in. at the straight end and inserted in the spout of an ordinary oil can reaching at least one inch below the point of the spout, thus forming a pocket, as shown by dotted lines in the sketch, that will catch all foreign matter that otherwise would plug up the taper spout. As anything that will enter the ⅛ in. inlet is bound to come out, it is always ready for business.



NON-CLOGGING OIL CAN.

E. A. KELSEY.

Santa Cruz, Cal.

Strength of Beams.

Editor:

The design of many parts of a locomotive is founded on the principles governing the strength of beams. The subject of beams is a rather extensive one and some of the formulas appear pretty formidable until the underlying principles are known. Beams can be divided into three general classes. Simple beams rest upon two supports, one near each end. A crown bar is a simple beam. A beam may have both ends fixed, as a crosshead guide. A cantilever has one end fixed and the other end free, as a crank pin, or the middle supported and both ends free, as the equalizing bar for the driver springs The load on a beam may be equally distributed or there may be one or more concentrated loads. When the beam itself is heavy the weight should be considered as a uniform load

A simple experiment will show the action which takes place in a timber or metal beam when under load. Take an ordinary ink eraser, or, better yet, a piece of rubber of the same shape, but rather open and porous, support it with a pencil under each end and press down on the middle. The pores in the upper part close up, those in the lower part become larger, and in the middle they neither open nor close. Place the piece of rubber with the pencil under the middle and press down the ends. This time the beam is a cantilever and the lower fibers close while the upper fibers open.

This experiment illustrates several terms which apply to beams. The pencils are the supports, your finger is a concentrated load, the part of the beam where the pores close is the compression member, as the fibers are in compression; that part where they open is the tension member, as the fibers are in tension, and the line through the middle is the neutral axis. This neutral effect extends through the beam and forms what is called the neutral surface. The neutral axis is any line in this surface.

It is usual to consider the axis which passes through the cross section of the beam, and in determining the effect of a load this neutral axis is what might be termed the starting point. The strain on any portion of the cross section depends upon its distance from this line, thus, a fiber 4 ins. from the line bears twice as much strain as one 2 ins. away, and the outermost fiber bears the greatest strain of all. The distance of this outermost fiber depends upon the shape of the cross section, for the neutral axis always passes through its center of gravity. If a thin section of the beam were balanced on a knife edge, the edge would correspond with the neutral axis. For regular shapes, as the square, rectangle, circle, I-beam, etc., the axis coincides with the center of the section. In other shapes it depends on the disposition of the metal. Thus, if a channel-iron has the web vertical the axis will cross the web at the middle, but if the web is horizontal the axis will pass through the flanges,

but near the web instead of through the middle of the section.

A beam usually fails by bending and breaking, but if it is very short or the load is close to the support, it may fail by shearing. The strength of a beam deepnds not only upon the amount of metal in the section, but also upon its arrangement with respect to the neutral axis. The tension member should be strong enough to resist flexure, or bending, and the compression member, if the beam consists of thin webs, should resist not only crushing, but also buckling sideways.

The engineering hand-books give tables of beam sections and different methods of loading, with the formulas for the section modulus, bending moment, maximum deflection, etc. In designing a beam the distance between the points of support, the load and the shape of the beam having been determined, the object is to find the size of section which will safely carry the load. The maximum bending moment can be determined from the method of loading, and from this the size of section can be calculated.

The bending moment may be called a measure of the force tending to rotate or bend the beam around the point of support. Its value depends on the weight of the load and its distance from the point of support. The maximum bending moment is given in the engineering tables for the usual methods of loading, but it can be found for any method by means of a diagram. Many of the beam problems can be worked out by means of diagrams, but I shall not discuss the method in this article.

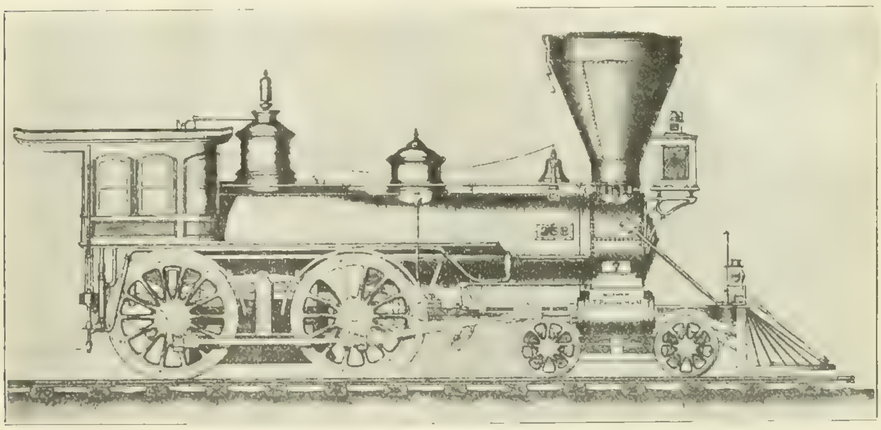
As the maximum bending moment is the force tending to bend the beam, a little consideration will show that the proper size of the beam can be found when the bending moment is known. If the beam is to resist bending there must be an opposing force at least equal to the bending force, and it is evident that this opposing force is due to the resistance of the metal in the beam. This opposing force is called the resisting moment and is usually denoted by the formula $S\frac{I}{c}$, in which S is the ultimate strength of flexure of the metal and c is the distance from the neutral axis to the outermost fiber of the beam. I, called the moment of inertia, is obtained as follows (I give here the formula for the benefit of those who desire to work out an example, but the theory of the subject is practically contained in the foregoing remarks):

Considering a cross section of the beam, suppose the surface to be divided into a large number of minute rectangles, like the tiles in a fireplace. These minute tiles might be considered as the ends of the fibers. The stress on any tile is equal to the area of the tile multiplied by the stress per square inch, and the force tending to rotate this tile around the neutral axis, that is, to bend the beam, is equal to the stress on the tile multiplied by the distance of the tile from the neutral axis. Suppose the beam to be 5 ins. from the neutral axis to the outermost fiber, and the maximum fiber stress to be 1,000 lbs. per sq. in. We will also suppose, for the sake of illustration, that the area of a tile is .1 of a sq. in. The stress, therefore, on the outermost tile is 1,000 x .1 lbs. The stress on a tile 1 in. from the neutral axis is one-fifth of this, or $\frac{1}{5} \times 1{,}000 \times .1$, and on a tile 3 ins. from the axis, $\frac{1{,}000 \times .1}{5} \times 3$.

The force tending to rotate this tile, or the turning moment about the axis, is the quantity just given multiplied by 3, the distance from the neutral axis, or $(\frac{1{,}000 \times .1}{5} \times 3) \times 3$; it may be reduced to $\frac{1{,}000 \times .1}{5} \times 3^2$. In the same way for a tile 2 ins. from the axis the moment would be $\frac{1{,}000 \times .1}{5} \times 2^2$, etc. Let r^2 be the average of the square of the several distances, 2 ins., 3 ins., etc., and n represent the number of tiles. Then $r^2 = \frac{2^2 + 3^2 + \ldots, \text{etc.}}{n}$ or $2^2 + 3^2 + \text{etc.} = nr^2$. But m, the total moment, which is the sum of the moments for all the tiles, equals $\frac{1{,}000 \times .1}{5}(2^2 + 3^2 + \text{etc.})$. Therefore $m = \frac{1{,}000}{5} \times .1nr^2$. Now .1n equals the area of one tile multiplied by the number of tiles, that is, the total area of the section, or A. The moment, $m = \frac{1{,}000}{5} \times Ar^2$. The factor, Ar^2, is called the moment of inertia and is denoted by I. The exact calculation of I is rather complicated, but its value for the usual section is given in the beam tables.

In the formula $S\frac{I}{c}$, the part $\frac{I}{c}$ is called the section modulus. S should be divided by a suitable factor of safety, f, so the formula becomes $\frac{S}{f}\frac{I}{c}$. I have already shown that $M = S\frac{I}{c}$, or, with a factor of safety, $\frac{S}{f}\frac{I}{c}$, therefore $\frac{I}{c} = \frac{M\,f}{S}$. The value of this is already supposed to be known, and the dimensions of the beam can be so calculated from the tables, where I is given in terms of the height and width, that the value of $\frac{I}{c}$ shall not be greater than the value already found for $\frac{M\,f}{S}$. Sometimes the value of $\frac{I}{c}$ is given directly for different sizes of beams, and in that case a suitable size can be selected from the table.

SIDNEY C. CARPENTER.
Plainville, Conn.



EIGHT WHEEL FAST PASSENGER ENGINE OF 186[illegible].

At the Franco-British Exhibition the "Invicta," the first locomotive that ran on the Canterbury and Whitstable Railway on its opening on May 3, 1830, is attracting much attention. It was designed by George Stephenson and built by Robert Stephenson & Co., Newcastle. It has cylinders 10 in. by 18 in., wheels 4 ft. diam., boiler barrel 3 ft. 4 in. by 8 ft., working pressure 40 lbs. per sq. in., wheel base 4 ft. 7 in. The boiler contains 25 tubes 3 in. diam. The weight is between 5 and 6 tons. The "Invicta" stands beside one of the largest locomotives of the South-Eastern and Chatham Railway, a 4-4-0 express passenger engine weighing 91 tons, 55 ft. in length, coupled wheels 6 ft. 6 in. diam., boiler pressure 180 lbs.

Miniature Railway.

Editor:

I enclose a couple of photographs which I thought might be of interest to readers of your magazine if you should find space to insert them.

No. 1 is a picture of a little narrow gauge pleasure train in East Lake Park, Los Angeles, Cal. The locomotive is complete in every respect with the exception of brakes; the engineer controlling the train with the reverse lever.

No. 2 shows the train returning over the trestle.

West Oakland, Cal. E. McBurney.

Old Brooks Locomotives.

Editor:

I have been enjoying reading your valuable magazine for several years and, although I have taken many others, I have never found any to compare with Railway and Locomotive Engineering.

I send you two photos, one of them shows an old American type engine of the "Pennsylvania Lines" hauling a passenger train out of the Union Station in this city. If I am not mistaken, I think that it is still running on the "L. & V." division of Vandalia Line.

BIG FOUR 0-6-0 BUILT AT BROOKS WORKS.

The other photo. shows one of the "Big Four's" 0-6-0 type locomotives ("98" class) with a "Lake Shore" box car.

These locomotives were built at the Brooks Locomotive Works, and they are serviceable machines.

If you see fit to publish these photos it will be appreciated by me.

Indianapolis, Ind. C. W. G.

A model of a new high-speed electric railway is being exhibited in London, England. The cars run on a single rail. There is also a guide rail above the car, so that derailment would be impossible unless a breakage occurred. The centre of gravity is kept low by building the motors in the wheels. Great economy is claimed for the system. The proposed speed is 50 miles an hour. Mr. Kearney the inventor expects that the North-West London Tube Company will adopt his system.

Thirty Days for Flirting.

Editor: While it is true that a railroad man will receive a large number of "knocks" in a lifetime spent on the road, it is also true that if he will keep his eyes and ears open, and look for it, he will also see and hear many funny anecdotes.

MINIATURE TRAIN IN EAST LAKE PARK, LOS ANGELES, CAL.

Several years ago I was employed on one of the large roads in the East as fireman. I was on a pusher engine with an engineer named Thompson. Thompson was a good man on an engine, and a good man to work with, but a perfect dude in dress and manners. If he could throw a girl a kiss, and she would smile back at him, Thompson was in heaven.

One bright sunny day I was with Tompson on our engine going east, and as we approached Willisburg I saw three ladies walking down the track toward Libertyville. Thompson could not see them, as they were on my side and the train we were pushing hid them from his view. But knowing his weakness and enjoying his monkey actions I let him know about the ladies on the track. He immediately took possession of my seat box, and as the engine passed the ladies Thompson was throwing them kisses with one hand and doffing his cap with the other. The ladies, seeing the kisses coming their way, commenced to laugh, and as our engine ran by them and they were hid by the tank, Thompson climbed out

CROSSING A MINIATURE LAKE.

on top of the coal and kept bowing and throwing kisses until the ladies were hid by a curve in the track.

A few days after that there came an order to the roundhouse to lay Thompson off for thirty days. It turned out that two of the ladies were the wife and daughter of the superintendent.

After that, when the boys wanted to guy Thompson they would catch his eye, bow and throw him a kiss, but we always had the front end of an engine or a box car to dodge behind.

A few months after Thompson got his lay-off I was firing for an engineer on through freight by the name of Duke. Duke was a fine engineer and a good partner to work with, and while a good looking fellow and a little vain about his appearance, he was not a dude, and was always ready for a joke.

One Sunday morning we were going west, and had taken the siding to let a passenger train go past. As soon as we stopped on the siding Duke got down to oil around. In a few moments I heard someone talking down on the ground beside the engine. I got my head out of the cab window in time to hear the following between Duke and a farmer:

"Be youns the inggineer?" asked the

OLD BROOKS P. R. R. ENGINE PULLING PASSENGER.

farmer. I could see Duke's chest swell out as he answered, "Yes, I am the engineer."

"Be youns the man what starts and stops the cars?" was the next question.

Duke's chest came out a couple of inches farther as he answered:

"Yes, I am the man that starts and stops the cars. When I say go, they go, and when I say stop, they stop."

The hayseed stepped back a couple of yards, and after looking at Duke a half minute remarked, "Well, it don't take much of a man for a engineer, do it?"

This was too much for me. I let a yell out of me that the "Con" heard back in the "dog house," and the front "shack" came back from the switch to see what was the matter. Duke shook his fist at me, but the farmer never smiled. The joke was too good to keep, and in a short time all the boys on the division were smiling.

I fired for Duke several months after

that, and whenever I saw that he was getting the best of me I would remark, "Well, it don't take much of a man for an engineer, do it?" That would always land him. FRANK PHELPS.

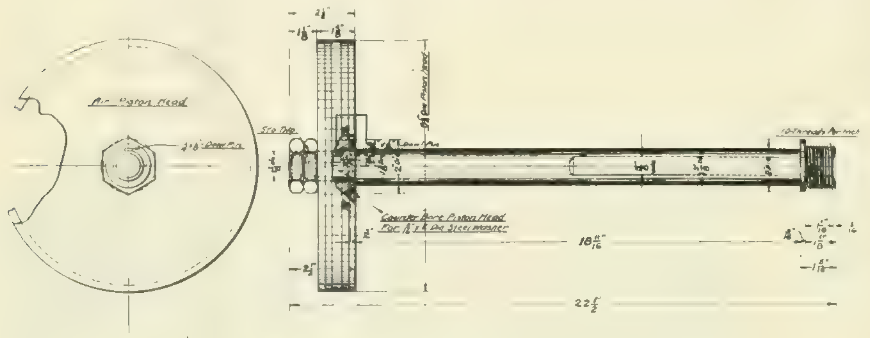
Fort Bayard, N. M.

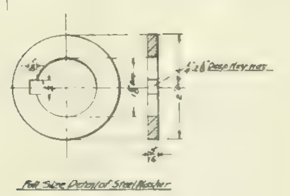
Air Pump Piston Rod.

Editor:

The weak point on all of our Westinghouse air pumps in the ⅛-in. shoulder on the piston rod. This shoulder works in the piston head, which invariably loosens it, thus causing many engine failures.

I would suggest making the following improvement: Counterbore the piston head to 2 ins. diameter and 3/16 in. deep. Put a 2-in. steel washer 3/16 in. thick in





PROPOSED PISTON FASTENING.

counterbore. This will make the piston rod shoulder tight against the washer. There would then be no possibility of the shoulder working in, and piston head working loose. Attached please find photograph of sketch showing same.

HENRY OTT,
Foreman of Air Brake Dept.
Lehigh Valley.

Sayre, Pa.

Loose Tires.

Editor:

Among the many troubles that beset the modern locomotive there are few that are more annoying than loose tires. They occur more frequently in summer as the heated rails tend to expand the rims of the wheels with which they come in contact more than the spokes of the wheels, which are to some extent kept cool by their larger exposure to the currents of air. When the tire slackens at a distance from the shop it is unsafe to proceed except at a very moderate pace, even if the wheels are furnished with bolts projecting through the wheel casting and set in a recess in the rim. The friction against the wheel flanges is so very great that a loose tire cannot be made to retain its position for any length of time if it has to depend on the points of two or three small bolts set at considerable distances from each other.

A temporary tightening can be made without removing the wheels if any means can be procured for heating the tire. In the absence of a gas or other regular tire-heater pieces of old rims or even bent pieces of rails may be heated and laid around the loose tire in such a way as to expand the tire sufficiently so that pieces of Russia iron cut into suitable strips may be inserted between the tire and rim of the wheel center.

It will be necessary to lift the wheel from the rail. This can be readily accomplished by jacking the axle and blocking between the binder and driving box. The operation will be facilitated by keeping the wheel as cool as possible and heating the pieces to be applied to the rim as hot as possible. It may be necessary to loosen the main and connecting rods, but the operation has been successfully accomplished without disturbing the rods. It is advisable to have as many pieces of heated metal as can be applied to the tire at once so that the rim may be equally heated.

It is good practice in such operations to loosen the springs. A pair of screw jacks under the front and back of the locomotive will readily hold it in position. Any operation that involves the application of extra pressure to an individual spring is not good practice, the tendency being to over-reach its resiliency and thus sow the seeds of some future trouble. It is hardly necessary to add that the rapid cooling of the heated tire after the strips have been inserted is an important feature in the tightening of the tire, the slower that the cooling process occurs, the more likely is the tire to stretch sufficiently to bring on another attack of loose tire at an early date. R. B. A.

New York.

Energy Consumed for Light

In a lecture delivered by Sir James Dewar on "Flame" before the Royal Institute in London he showed the large amount of energy expended in the production of a small amount of light. The following figures show how inefficient the various lighting devices now employed are from a scientific point of view: Candle—Percentage of light, 2; non-luminous energy, 98. Oil—Percentage of light, 2; non-luminous energy, 98. Coal gas—Percentage of light, 2; non-luminous energy, 98. Incandescent lamp—Percentage of light, 3; non-luminous energy, 97. Arc lamp—Percentage of light, 10; non-luminous energy, 90. Magnesium lamp—Percentage of light, 15; non-luminous energy, 98. Incandescent lamp—tage of light, 99; non-luminous energy, 1.

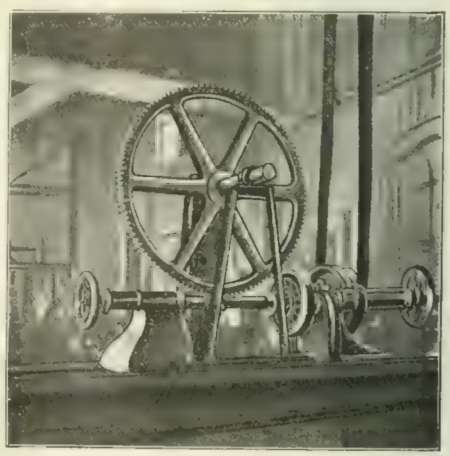
New German Signals.

Several recent railway accidents in Germany have been traced to the failure of engine drivers to see signals, and this circumstance has caused the Prussian railway administration to adopt a new signal apparatus. The feature of the new system lies in the warning given the engine driver that he is approaching a signal about 110 yards before the signal itself is actually reached. This is accomplished by the use of an electric cab signal system which arouses the driver's attention by ringing a bell and exposing a white slide directly before his eyes in the cab. With his attention thus stimulated the driver will have no excuse for running by a signal in a fog.—*Railway Magazine.*

Milling Done on Lathe.

Editor:

The enclosed photograph shows a forty-inch gear wheel having the teeth cut in a lathe. The milling cutter was revolved



GEAR WHEEL MILLED ON LATHE.

between the centers of the lathe and the wheel was worked back and forward over the cutter by the cross-feed.

W. J. MCLEAN, Master Mechanic,
Bellingham Bay & British Columbia Rd.

Bellingham, Wash.

General Foremen's Association.

TOPIC NO. 7.—THE QUICK DISPATCHING OF ENGINES AT TERMINALS AND HOW TO HANDLE MOST ECONOMICALLY.

The question of quick dispatching of engines at terminals is a very live subject, and a very important factor toward successful railroading.

The management of the various railroads of to-day want all the power possible to be in continuous service, earning dollars and cents, instead of lying idle in the round-house at the various division points. The question is: How shall this be accomplished in the shortest given time?

There are several important features that must play a part in this, viz.: Advance information, harmony, efficiency, promptness, aggressiveness and well planned and arranged conveniences.

Advance information: The round-house foreman should keep in close touch with the train dispatcher, as to what engines are coming in, and what time they are expected. The round-house foreman should also be advised in advance of the nature of repairs that might be needed upon the arrival of the engine, provided the repairs be other than ordinary running repairs. This will enable him to get a line up of the material needed and distributed to the various departments, and have it advanced as much as circumstances will permit.

Engineers should lose no time upon arrival in examining their engines, and make their report, reporting only such work as is necessary, thus enabling the round-house foreman to get his work-slips lined up by the time the engine reaches the house. The engine inspector should be alive to the situation, and can be of valuable assistance to his foreman by getting his inspection done immediately when the engine arrives. He should be on the lookout for engines coming in, so that no delay will be caused by his inattention to business.

Perfect harmony should exist at all times between the train dispatcher, round-house foreman and the heads of the various departments; all friction should be eliminated, and each one should be loyal enough to work for, and advance the best interest of, the company employing him.

An efficient organization is quite an important factor in the quick dispatching of engines, and should be able to cope with the situation at any and all times. The round-house foreman should have an assistant outside, having charge of the dispatchers, clinker-pit force, table men and common help around the house. With a live man in this position some wonderful results can be accomplished. He should relieve the foreman of the supervision of dispatching engines and other outside work, thus enabling him to keep in close touch with the force doing the repair work.

The outside assistant should be notified as to what engines are wanted first, such engines as are wanted in specified stalls, engines wanted in without coal, sand or water; also be furnished with a list of engines due for wash-out each day, and if he be a live man he will immediately notify the round-house foreman every time an engine due for wash-out comes in, and find out if he should put her in the wash-out stall or not. Telephones should be used wherever practicable, as many steps and much time will be saved by their use.

The foreman and his assistant should keep in close touch at all times; in fact, the foreman should give his assistant a general line-up from time to time as conditions change.

Engines from the time of arrival to the time of leaving should receive prompt attention from all concerned, working on the "Do It Now" principle, and not putting off till to-morrow what can be done to-day.

There should be sufficient force of men to accomplish the desired results, and here is where the outside assistant can get in his work by seeing that engines are not kept waiting to be dispatched.

Upon the arrival of an engine at the terminal she should immediately be taken in charge by the dispatcher, who should see to it that the boilers are filled with water, provided there is no boiler work to be done or flues caulked. He should examine the fire-boxes while the fire is bright, and if everything is all right he should consult with the assistant as to whether the fire should be knocked out or simply cleaned. If no boiler work is to be done the fire should be properly cleaned, thus saving contraction of the flues, also saving time and fuel.

Now, as to the conveniences, these should be so well planned and arranged that there should be no reverse movements of an engine. There should be at least two or more tracks leading from the turn-table so that the outgoing engines will not interfere with the incoming engines. The turn-table should be operated by air or electricity, as the operation of the table by hand is old-fashioned and antiquated. Modern clinker pits should be used and conveniently located, the sand towers and water tanks should be so located that the engine will be advancing with each operation.

The round house should be well lighted and ventilated, as men will work to better advantage. It would also be a good plan in large and busy round houses to divide the force so as to work the full twenty-four hours, thereby taking care of the running repairs promptly and avoid holding the engines over. Engines that need more than is commonly known as running repairs, however, should be held over for the day force, when the round house is backed by the machine shop, blacksmith shop and boiler shop, the work being done more cheaply in the day time than at night.

By this plan of taking care of engines during the entire twenty-four hours a larger number of engines can be had for the prompt movement of traffic.

All round houses should have a few machine tools, so that if it is necessary to drill a hole, turn up a bolt, or any small job, it will not be necessary to start up the entire machine shop; or if this is not practicable a few tools should be grouped in the machine shop and run with a line shaft, connected with an independent motor. This should be so arranged that the motor should be used only at night, the shaft being driven from the main shaft during the day.

When engines are held in for other than light repairs, and after being re-examined by the inspector, the round-house foreman should look over his work reports; work which requires the assistance of the machine shop or other departments should be removed and taken to the respective departments at the earliest possible moment so as to give them a chance to get their work done without delay to the round-house force, thus working hand in hand with each other. The foreman of each department that has work to do should be notified of the time the engine is expected to leave the house, so that they may be governed accordingly, always giving running repairs the preference.

Wherever it is practicable separate stalls should be used for washing-out purposes as it does not interfere with the rest of the round-house force while engines are being washed out. These stalls should have good drainage.

A hot-water plant is a very necessary adjunct to a round house, as by the use of hot water for washing-out purposes the boilers are not subjected to such severe strains due to expansion and contraction as when washing out with cold water.

The hot water could be used for filling up the boilers after they are washed out, so that an engine can be gotten into service in the shortest time possible.

Harmonious co-operation between the mechanical and operating departments, especially during periods of congestion, or when power is in great demand, will facilitate matters greatly, and be a great factor in accelerating the movements of engines at terminals.

An aggressive progression policy should be adopted by each and every one, each man putting it up to the next one to see that no delay is caused through his negligence.

WILLIAM HALL,
C. & N. W. Railway.

Escanaba, Mich.

This paper, read at the General Foremen's Association Convention in Chicago, was crowded out of our August issue.

Correctives in Link Motion Design

By Roger Atkinson

The Shifting link motion was one of the best steam distributing devices ever devised, but like everything else in the mechanical world it is not perfect. There are one or two interesting modifications, or one may say correctives which are often introduced into link motion design and which when intelligently done produce very satisfactory results.

One of these "correctives" consists in

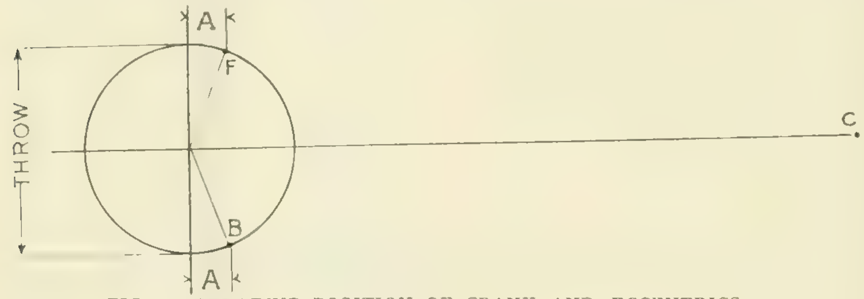


FIG. 1. RELATIVE POSITION OF CRANK AND ECCENTRICS.

avoiding the effect of large mid-gear lead in forward gear by sacrificing the accuracy of the back gear motion. The effort here is to make a step in the direction of constant lead such as is given by Walschaerts gear. The sacrificing of the back gear for the sake of the forward gear in the Stephenson link motion is of course only an approximation, but it works very well in ordinary practice.

If a diagram be made showing the relative position of the crank and the two eccentrics for one side of a locomotive, it would appear as in Fig. 1, where

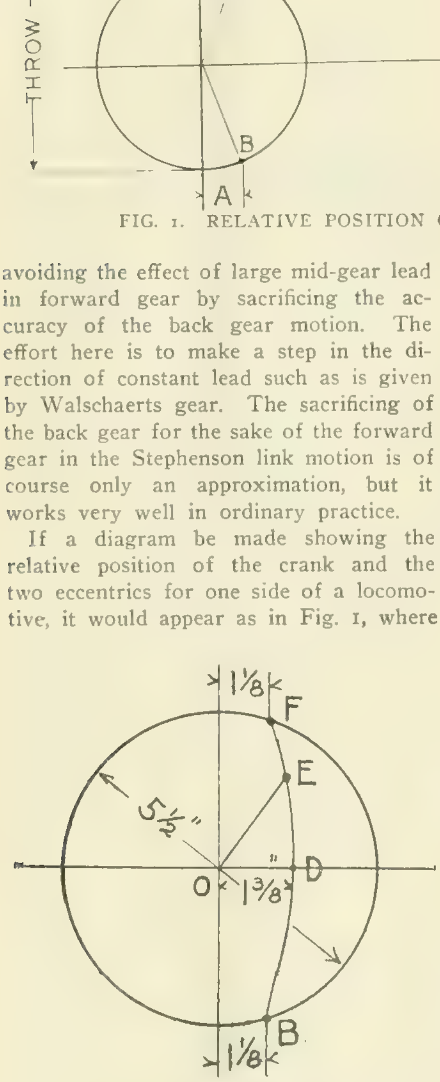


FIG. 2. FULL AND MID-GEAR LEAD.

C is the crank pin and *F* and *B*, the eccentrics located on the throw circle. The distance *A* is the sum of the lap and lead of the valve if the top and bottom rocker arms are equal in length or bear the same ratio to the sum of lap and lead that the bottom rocker arm does to the top one. When the lever is in full gear forward, the *F* eccentric has practically entire control of the valve, and the *B* eccentric controls when in full back gear. When notched up, the valve is under control of both, and either one dominates according as the link block is above or below the center. Their effects are of course equal in mid-gear. In this position the half travel is equal to the sum of the lap and mid-gear lead, which is greater than full gear lead. This can be shown on the diagram, Fig. 2, thus:—Assume lap to be 1 in. and the lead full gear ⅛ in.; the lead, mid-gear ⅜ in.; the throw 5½ ins., and we can locate the mid-gear lap and lead on the center line at *D*. The valve then acts in mid-gear as if there were only one eccentric with its center at *D*. If now a circle be drawn through these lead points, *F*, *D* and *B*, any point in it, as for instance *E*, will represent the combination of the movements of *F* and *B* upon the valve, as though there were only one eccentric at *E* with radius *E O* when notched up on the link as far as *F E* is upon *F B* in proportion to length.

If therefore the back gear eccentric be set with less lead, say ⅛ blind, so that the sum of lap and lead is ⅞ in., then point *B* will be ¼ in. nearer the center line, and the curve *F D B* will be more nearly parallel from *F* to *D* with the centre line, or in other words the mid-gear lead will be decreased ⅛ in. and will then be only ¼ in. This is called sacrificing the back gear lead. The curve *F D B* is not a true circle but is parabolic, but it is so far approximately circular as to be sufficient for purpose of illustration. The full forward gear lead is not appreciably affected by a change in the location of the back gear eccentric, but all intermediate positions are affected in proportion to their approach to the back gear. The convexity of the curve *F D B* decreases with longer eccentric rods, and vice versa, and in this respect follows the curvature of the link.

Another very interesting "corrective" is the position of the saddle pin, or the point of suspension of the link. The object is to get the points of cut-off and exhaust as nearly alike as possible for the front and back stroke.

In the shifting link motion as generally used on American locomotives the saddle pin by which the link is carried is always placed behind the centre line of the link. If it is on the center of the link, and the motion is run over, it will be found that the half travels are very unequal, and consequently all the points of cut-off and exhaust are very different on the front and back ports, the amount varying with the design, as to length of eccentric rods, distance between blade connections on link, throw of eccentrics, etc. It will be found that setting the saddle pin back ¼ in. improves it somewhat as to equality of half travels and other points, another ¼ in. set back improves it still more, but not so much as the first, and so on; so that, speaking generally, if the pin is set back ⅛ in. for each foot of length of the radius of the link it will give very fair results, in fact a little more than this is generally better. For instance, a set

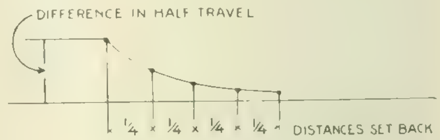
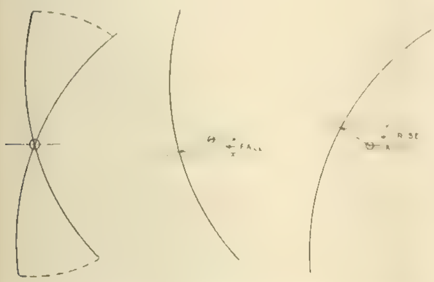


FIG. 3. DIAGRAM OF TRAVEL VARIATION.

back of 11/16 in. would be the above allowance for a link radius of 5 ft. 6 ins., but ¾ in. set back is decidedly better, and ⅞ in. or even 1 in. set back produces correspondingly small improvements in the equality of cut-off and exhaust points, as shown in Fig. 3.

There is another thing to be considered, however, that is, if the saddle pin is on the center of the link, the link is rotated about the pin without rising or falling, Fig. 4, but if the pin is moved back the link rises and falls, like the head of a hammer when rotated, in proportion to the amount the saddle pin is moved back, Figs. 5-6, and as it moves up and down while the block on the rocker arm does not, there is considerable slip between the link and the block, which introduces wear and lost motion in proportion to the amount set back, so that in the example before given, the saddle pin would probably be located ⅞ in. behind the center. It is this amount of rise and fall of the link which corrects the irregularity in the half travels and other points, since if the link be raised or lowered when in an inclined position it moves the block horizontally and therefore the valve also, but when in a vertical position it may rise and fall without moving the valve, and it is easily seen on a motion table that both these conditions exist at different points in the revolution. A still further improvement

can be made generally by placing the saddle from 1 in. to 2½ ins. above the center of the link as well as back of the center. This has the advantage that it decreases the slip in forward gear where the motion is mostly in service, but adds to the slip in back gear where the wear is not so detrimental. This is another instance where sacrificing something of the accuracy of the back gear adds to the efficiency of the forward.



FIGS. 4 5. AND 6 SLIP OF LINK BLOCK.

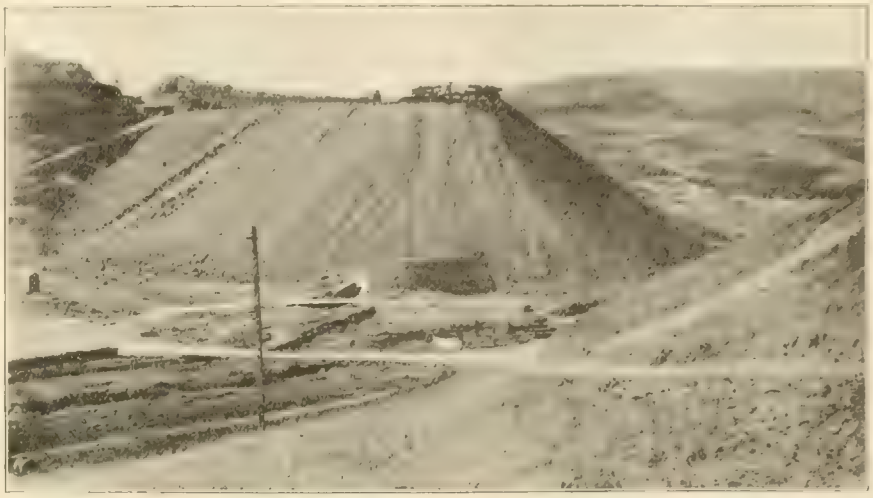
There are other points in valve motion design which are necessary to be carefully adjusted in order to obtain equal cut-off and exhaust at all points, for instance the position of the top of the lifting link when in mid-gear should be somewhat forward of the center of rocker shaft; and where the link radius is very short, the curve of the location of top lifting pin has an appreciable effect.

The Great Western Railway of England have put in service several locomotives, the largest in use in England. Measuring 71 feet 2 inches in length, including tender, and weighing in all 143 tons, they fairly measure to the average American freight engine. The working pressure is 225 lbs. per square inch, with four cylinders 15 inches by 26 inches. The engines are of the 4-6-0 type, the boiler being of the extended wagon-top variety, and is fitted with a superheater of special design, as also is the Belpaire firebox. The four cylinders are of the single expansion type.

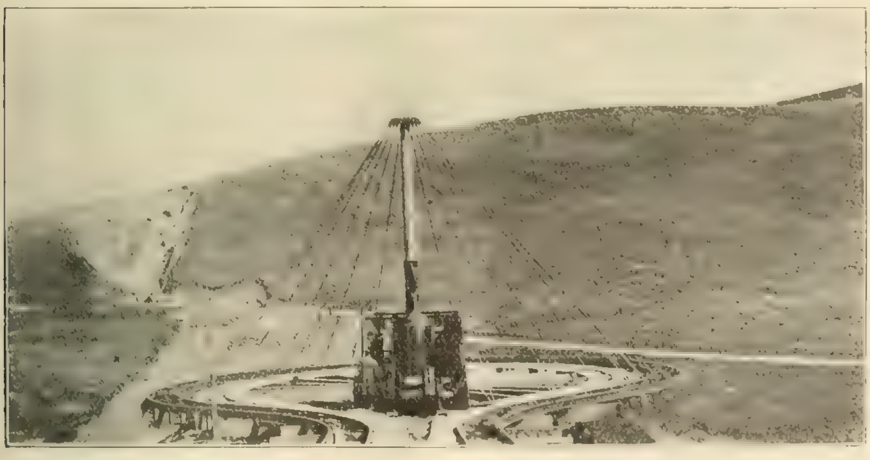
A Continuous Unloader.

The Continuous Unloader here shown is a device, by means of which, cars may be unloaded continuously, and with small delay. It was designed to take the place of trestles in the construction of high embankments, and was recently given a practical test on two of the largest fills on the Western Pacific Railroad at Altamont, Cal., and has proved satisfactory. The work being well done, in less time, and for less money than by the older methods in use for this class of work. The danger from the use of high temporary trestles is eliminated by this method.

The Unloader consists of a circular track, resting on radials, and partially supported by rods, suspended from a mast, in the center of the structure. The entire frame rests on rollers, under which are short stringers, and is moved ahead by its own power, ten or fifteen feet at a time, as the work progresses. On the unloader is a double drum hoisting engine, which operates a cable that leads round the circular track, between the rails, and is held in place by cast rollers. A train of six, eight, or ten loaded industrial railway cars are pushed by a locomotive to the unloader, where they are picked up by the cable and hauled around. Three or four yard, side dumping cars, 36 in. gauge, are used. The cars are unloaded while in motion, one man, with a dumping stick, dumps them as fast as they come. Two men knock the chains loose, and two men pull them back and chain up. One engineer and two block men complete the force required to operate the unloader.



CONTINUOUS UNLOADER ON THE WESTERN PACIFIC.



CLOSE VIEW OF THE CONTINUOUS UNLOADER.

While the cars are going around the circle, the engine switches from the delivery track to the receiving track and is then ready for the empties. The empty cars having been delivered to the engine. the ball on the cable is pulled back and is ready for another train. On this work, trains of cars were handled faster than a 65-ton steam shovel, side cutting, in good material, could load them. It can easily handle all the material loaded by two steam shovels. The time consumed in moving the machine forward is about 90 minutes, and this work is usually done during a meal hour, so as not to delay the steam shovel. One fill on which this unloader was used, was 125 ft. high and 750 ft. long. The other was 114 ft. high and 1,200 ft. long. The unloader is readily taken apart, and can be shipped on any ordinary flat car.

The H. W. Johns-Manville Company, of New York, have issued a little folder on how to preserve gauge glasses. The gauge glass preserver is a specially designed washer which not only makes a tight joint, but the rubber lips of the gauge glass preserver, coming between the glass and metal parts of the gauge cock, allow for the difference in expansion and contraction and thus prevent the glass from breaking.

The Gilbert Gauge Glass Preserver, as it is called, is made of the highest grade rubber stock for the sake of durability. It is said not to harden and is thus suitable for hot water or steam.

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A Possible Alternative.

At the present time there is a certain amount of business depression throughout the country, though the skys are certainly clearing and railroads are expected by many to make some move to help the situation. Transportation companies are vast collectors of money but they are also vast spenders. They use an enormous amount of all sorts of manufactured products. One may say it with truth that a railroad buys for its own use manufactured articles from a needle to an anchor. The prosperity of our railroad goes hand in hand with the prosperity of the country. In fact as President Winchell of the Rock Island recently said to the Traffic Club of Chicago: "The prosperity or the failure, the woe or the weal of the transportation companies is written in the books of the commercial houses of this country, and I think perhaps that is true to a greater extent than the commercial people have ever realized."

This is practically admitted by everyone who has given even superficial attention to the situation and there have up to the present been only two alternatives presented as a solution of the problem. These alternatives are either a general reduction of employees' wages or an increase in freight rates. Railroad men are naturally opposed to any wage reduction and the manufacturers are against an increase of rates. The object sought in each case is the same, viz.: that railroad companies may have more money at their disposal, to spend.

The situation is grave but it is not without hope, because things have without doubt taken a turn for the better, and there is one partial solution of the problem which is not contained in either of the alternatives which have been put forward. In fact it may be possible to see the return of normal conditions without either an increase of rates or a decrease of pay. This may be done by the legitimate reduction of operating expenses, not by laying off men or paying them less for their services, but by the co-operation of the whole railroad staff in an earnest and systematic effort to practice economy in the true meaning of that word. Not an oil famine here or a spasmodic attempt to pinch there, while wasteful practices are unchecked yonder.

There are a great many things which railroad employees themselves can do, without experiencing any hardship in the performance of their duties, and which being cumulative in their effects are powerful in the production of results. It has been truly said that one swallow does not make a summer and one conscientious fireman cannot save his road, but think of the bulk result in dollars and cents if every fireman all over the United States, Canada and Mexico were able to put a stop to the waste of coal caused by steam blowing off at the pops for the entire month of September.

We remember when the depression of 1903-4 overspread the country, hearing of a certain master mechanic who made an effort to save coal by giving greater attention to the washing out of boilers. His object was to render the heating surface of his boilers more effective by frequently removing heat resisting scale on flues and sheets. We do not say that these particular instances alone will bring back prosperity to railroads or to the country at large, but we instance them as indicating the line of thought and action which if put in practice could not but help.

Another possibility in the same direction lies in the hands of the mechanical engineer and the shop foreman, and that is the fair cost reduction of articles produced in the shop, not by cutting prices but by the careful designing of castings, forgings, etc., so that their manufacture shall be comparatively easy and by the adoption of such methods as will tend toward increased output. These objects have already been pursued with marvelous results, and the fact that attention is called to them is no reflection on the excellent work that has been accomplished in this direction, but rather because it is known that even a rapidly advancing army may find it necessary, in the presence of peculiarly pressing circumstances, to reach a certain point by a forced march. Such extra exertion is but the exhibtion of the reserve force always to be found in a well organized and disciplined army, and only such an army can so respond in an emergency.

Railroad men in this country are a well trained, intelligent and efficient body of men, who understand their business and appreciate the quality of their acts. The excellence of the work done by engineers on many of our leading roads in the matter of safe railroad operation as evinced by the records of the so-called surprise checking system in the matter of signal observance is proof, if any were needed, of the ability and willingness of the men of all ranks to co-operate fully and loyally in maintaining a high standard of efficiency. The same spirit applied to the even further economical operation of our railways now in what we may call the last days of the commercial depression, can only have the most beneficial effect. In the tug-of-war now on, let every employee in whatever department he may be, take a fresh foot hold, a firm grip on the rope, and throw his full weight of muscle and brain into the game and pull the now weakened hard times squarely and definitely over the line.

Electrically-Driven Lathes

The rapid adoption of electricity as a motive power in lathe work is a gratifying sign of the spirit of progress which is one of the best characteristics of the age in which we live. The mechanical world has happily outgrown the absurd notion that it was wise to let well enough alone. It is not necessary to make invidious comparisons between the steam engine and the electric motor. It is for the intelligent engineer to discern where either or both are best suited for the work to be done. It does not require much abstruse calculation to know that the steam engine set in some remote corner loses much of its power when its force is conveyed through extended lines of shafting or run through far-reaching ropes, or through a bewildering maze of belts.

With regard to the application of electricity as a motive power, as is well known, there are three general methods of electric transmission. There are, the direct current system, the alternating-current system, and the motor-dynamo or re-generating system. The selection of these systems is naturally governed by the conditions surrounding the work to be accomplished. In regard to lathes and other machines the electric motor of the alternating-current type is acknowledged to have several advantages, especially in automatically adjusting itself to give constant speed as different loads are placed on it. On the other hand the variable speed motors are generally applicable where they are always under the immediate control of an operator, as on street cars.

In the matter of speed variations in lathes and other machines with spindles having a velocity of 24 to 1, the variation can readily be obtained with four runs of gears and a speed variation in the motor of 3 to 1. The speed control of motors is usually arranged in one of three ways. Either by altering the total amount of magnetism in the fieldcoils of the motor, or by changing the armature voltage, or by the number of poles and the armature connections.

Every calculation in regard to the important item of cost that we have seen all point in favor of the electrically-driven lathe. Besides reducing the cost of power, the increase of output cuts down the cost of labor. In many cases the product is improved and there is every indication that at no distant date not only every lathe but every metal-working machine will be equipped with its own or group-driven electric power.

To Reduce Smoke.

In an effort to secure still greater economy in the use of coal, and, at the same time, to reduce the smoke nuisance, the Pennsylvania Railroad has instituted a special campaign of education among its engineers and firemen. A general order has just been sent out all over the lines east of Pittsburgh to the effect that "smoke means waste and must be avoided."

The company has five assistant road foremen of engines at work in and near Pittsburgh instructing firemen with a view, especially, to reducing the quantity of smoke emitted by engines. Now it is the purpose of the railroad to reduce the smoke not only in places where the smoke itself is particularly objectionable, but all over the system, in order to secure more economy in the use of coal.

What even a small economy in the use of fuel will mean to the Pennsylvania Railroad, in addition to the reduction of smoke, is seen in the fact that on the Pennsylvania Railroad proper, it required last year approximately 10 lbs. of coal—just about one large shovel full—to generate the steam necessary to haul one freight car one mile. The safety valve of an engine, if left open a minute, will lose an equal amount of steam. The Pennsylvania Railroad last year hauled 1,248,449,300 freight cars one mile, and its coal bill was about $10,000,000. Therefore, the saving of even one per cent., by more efficient handling of coal, will result in a saving to the company of $100,000 annually.

In this general order the company has gone into the very elementals of locomotive firing, in the attempt to impress anew upon the men the importance of attention to the most minute details. Coal no larger than three inches thick may be used; tenders must not be overloaded so that coal is dropped along the track; grates and ash pans must be kept in repair.

Scrapers.

The marked improvements in planing and milling machines and their general use in all kinds of metal work has diminished the importance of the scraper in the list of machinist's tools. Its use is also not nearly so general on valve seats and cylinder heads and other work as it formerly was. In spite of these curtailments it is, however, indispensable in fine fitting and its proper construction and use merit attention.

The scraper should be forged from a piece of flat steel about one inch wide by one-eighth thick, and it is good practice to slightly upset or thicken the tool towards the point. This form has the advantage of furnishing two cutting edges if the tool is properly ground. If only one cutting edge is desired the tool may be drawn out thinner towards the point and ground with the face slightly bevelled. It will be noted that the working edges of the tool will cut much more readily when the angle is slightly under ninety degrees. The face should also be rounded lengthwise to prevent the corners from digging into the work. It is also noteworthy that a broad, straight cutting edge has the undesirable quality of producing a wavy surface, whereas a slightly rounded cutting face will work smoothly and precisely if properly tempered and sharpened. The tempering should be as hard as the steel will permit, and as the cutting edge should be of the finest it is necessary to finish the edge of the tool on an oil stone. Even the best of steel scrapers will require frequent applications of the oil stone.

In cases where the planing machine work may not be of the best a form of scraper that is very effective may be made by turning down the cutting end of the tool. The cutting edge should be ground with a slight clearance making the cutting angle considerably less than ninety degrees. A scraper of this kind will remove much material in a short time but it is unsuitable for finishing. The best mechanics usually have a number of scrapers adapted to the various kinds of work passing through their hands. Very necessary among them are round-nosed and concave scrapers suitable for work on joints of steam pipe rings, etc. A three cornered scraper, generally made from a three cornered file is very useful in scraping bearings or other circular work. In using the scraper on flat surfaces it is well to change the direction in which it is used occasionally as its constant operation from one point is apt to induce irregularities on the surface of the metal.

The scraper properly used is a useful tool.

High Speed Tool Steel.

The question as to what are economical limits of speed for cutting tools has been very much debated during the past few years, and Mr. L. P. Pomeroy, at a recent meeting of the Central Railway Club. Interest in the subject was aroused by a demonstration made at the last Paris exhibition at which steel tools, prepared by the Taylor-White process, were shown to be capable of cutting thick spiral shavings from a mild steel forging at a speed which caused them to come off at a blue heat, while the point of cutting-tool itself was visibly red-hot. The interest in the subject was increased rather than diminished when it was discovered that the properties of the Taylor-White steel depended mainly on heat treatment. It followed from the discovery that while the cutting qualities of air-hardening steel were seriously injured if it was heated up to a maximum temperature, between 1,350 and 1,725 degs. F., and then allowed to cool, they were greatly improved by heating beyond this point up to about 2,000 degs. F., in fact to the point at which the steel begins to crumble if touched, before the steel was allowed to cool.

Continuing, Mr. Pomeroy said that in repetition work, forgings can be done closely to size, and only fine cuts need be taken. In general work, however, lathes, which can take heavy roughing cuts are necessary, for it is cheaper to forge only approximately to size, and afterwards remove the excess material in the lathe, when a small number of pieces of any one kind are required. The amount which may nowadays be economically left on the forging is greater than it was, because it is less costly to produce a ton of shavings with high speed steel than with low; not because the work required to machine off the ton is any less, but because the "on" cost charge is smaller.

The vertical pressure exerted on the point of a tool of ordinary shape is 100 tons a sq. in. for soft steel, and about 80 tons for cast iron. These figures appear not to vary much with either the area of the cut or its shape, and to be independent of the speed. The cutting force is the same whether carbon or high-speed steel is used, and, the standard cut having been assumed the same for both, the power required depends only on the speed of cutting.

High-speed steel has increased the speed about threefold for the heavy and moderate cuts, and about fivefold to sevenfold for light cuts. The power required is therefore from threefold to sevenfold as great for high as for low speed steel.

Heavy cuts are more economical than light, if both are taken at their appropriate speeds, because the high-speed steel will cut a greater weight per unit of time, without damage; and also because the gross power is less per unit of weight machined.

Perhaps one of the most useful of all applications of high-speed steel has been the manufacture of twist drills from it. In former days many attempts were made to produce twist drills from the ordinary self-hardening steel with usually but indifferent success. Now, however, drills of high-speed steel are to be found in most shops, and high-speed drill trials have been made very severe. For the purpose of trial a number of drills were taken from stock, so that the results would be representative of the capacity of drills usually manufactured. The results show beyond any possible doubt that under ordinary conditions, and in suitably-designed machines, it is practically impossible to break these drills.

Doubts have arisen at times as to whether high-speed steel would take finishing cuts. In the early stages of its manufacture, such contentions were somewhat justifiable, but the early difficulties have now been largely overcome.

Mr. Pomeroy said he wished it to be understood that he did not state that rapid-cutting steel will produce a high finish under all conditions, for with certain metals a special carbon alloy steel, suitable for hardening in water, will give greater satisfaction; but, on the other hand, there are very many operations where high-speed steel will produce the desired finish, and by reason of greater endurance continue to work for very much longer periods than water-hardening steels, and in such cases there can be no doubt of its advantage for this work.

First Aid on the Pennsylvania.

For some time past Pennsylvania Railroad employees have been carefully instructed in the art of rendering first aid to the injured.

There has been a large attendance at the lectures on the subject which has shown the interest taken in it by the men. At a lecture in Verona 646 employees were present, at the 28th street station in Pittsburgh 317 employees attended at one time, while at various other meetings held the number exceeded 150. About 12 lectures are given each month.

Instruction in first aid is given by the medical examiners of the relief department. Employees are taught how to place injured persons on stretchers, and how to carry them. They also learn to take primary care of wounds, fractures, burns, and shock, without the use of drugs, until medical aid can be had.

The Pennsylvania has furnished stretchers to all baggage, mail, express, work and wrecking cars, terminals, yard offices, shops and important stations. Locomotives, cabooses, terminals, yard offices, shops, and important stations are supplied with "First Aid" boxes.

First Aid is simply knowing what to do and how to do it.

Book Notices

Mechanical Engineering and Machine Shop Practice, by Stanley H. Moore. Hill Publishing Co., New York. 502 pages 6 ins. x 9 ins. Ornamental cloth, profusely illustrated. Price, $4.00.

The latest book from the Hill Publishing Company is a very comprehensive manual designed for the younger men in shops, and for general reference in every department of mechanical engineering as applied to machine shop practice. The field is covered completely and the careful classification of subjects and their relation to each other is such that the student follows with growing interest the logical sequence of the mechanical problems. These are treated with a degree of fullness that leaves nothing to be guessed at. Beginning with materials and passing through the various departments of tools, machines, processes, power generation and transmission, the work fittingly closes with a highly interesting chapter on motor drives and motor-driven machine tools. The work is divided into twenty chapters. There are several hundred excellent illustrations. The paper and press work are of the best and the work is in every way creditable to author and publisher.

Reinforced Concrete. A Manual of Practice. By Ernest McCullough, M. W. S. E., Civil Engineer. Published by the Cement Era Publishing Company, Chicago. 128 pages, cloth. Price, $1.00.

Mr. McCullough has been long and favorably known as an engineering writer and in the department of construction of buildings where steel and concrete are used, he has shown a thoroughness which can come only to men of wide experience. In the work before us, the principles stated are the result of personal observation, and apply to all kind of work in reinforced concrete. The classification of the book is excellent. Beginning with the strength of beams, it leads naturally to loads on beams, sizes of columns, walls, tanks and footings. Design and cost and forms are treated of as well as the conduct of work. The work closes with an exhaustive treatise on tools which is alone worth the price of the book.

The Plane Table and its use in Surveying, by W. H. Lovell, topographer U. S. Geological Survey. Published by the McGraw Publishing Co., New York. 50 pages with illustrations. Cloth, $1.00.

It is a remarkable fact that the Plane Table, which has been in use for over three hundred years in European countries, is little known in America. A few of the more advanced technical schools are beginning to give some instruction on the subject. The author of the work before us points out very clearly the many advantages of the instrument, especially for railroad and land surveyors. The style of the author is admirably suited for educational writing. His language is terse, clear and elegant. The illustrations are readily understood, and the adoption of Mr. Lovell's work as a text book on the subject would be a lasting benefit to surveyors generally.

Fuller's Complete Manual of Questions and Answers for Examination on the Standard Code of Railroad Rules and Train Rights. Published by A. W. Fuller, R. F. D., No. 1, Hartland, Me. 128 pages; boards. Price, $1.00.

This compact little book, comprising 611 questions and answers, is designed to furnish a catechism on the standard code of train rules and telegraph orders as used on the principal railroads in America. It is the work of a practical railway man, and presents in a very handy form the information calculated to assist brakemen and firemen who are endeavoring to qualify themselves for promotion. The work is classified in sections, and leads on by single-track rules and signals to the more involved regulations in vogue on double and also three or four tracks.

Several Things.

Among the many articles of interest which are to be found in our columns this month the Bank Firing discussion has been carried a stage further, and the straightforward expression of opinion backed by experience is valuable. It exemplifies the old adage that "circumstances alter cases."

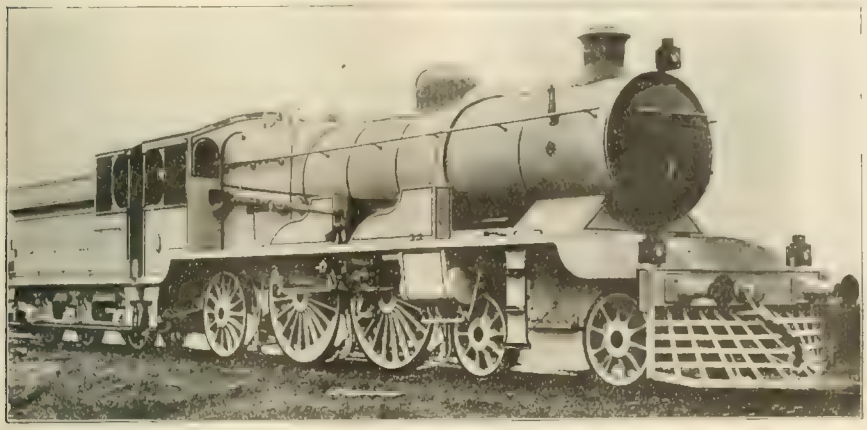
A very interesting article on link motion correctives practically answers a number of questions which come up in the design of the shifting link motion. Mr. Quayle, in his address to the General Foremen's Association, said that with a little study any of them could master higher mathemathics. This should be of encouragement to those who get puzzled with the intricacies of link motion. We print this month a synopsis of Mr. Quayle's address to the general foremen.

There is also a very carefully reasoned-out theory of the derailment of tenders, with the calculations given in the shape of a few simple formulas which will enable the reader to get at the author's full meaning. A letter to the editor on the strength of beams shows how these simple load carriers must be viewed by the designing engineer. The paper, No. 7, read at the General Foremen's Convention, on the "Quick Dispatching of Engines at Terminals and How to Handle Most Economically," appears in this issue, having been crowded out of the August paper. All these topics and any other live matters of interest to railroad men which our readers may send in are suitable to our columns.

Recent Locomotive Types Abroad

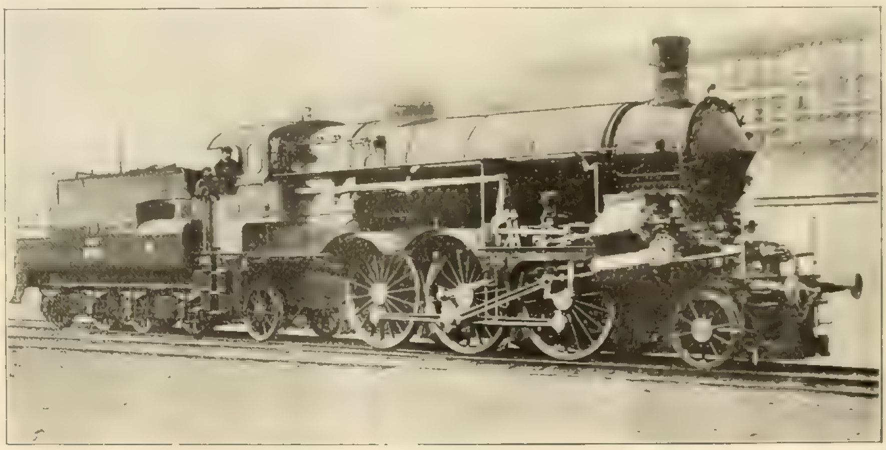
By A. R. Bell

Novelties in locomotive design abroad appear to be less frequent than they were a year or two ago, most designers being in favor of standardizing more. The Atlantic type engine is now favored for express passenger traffic in almost all countries, the latest being for India, where the Bengal-Nagpur Railway recently put in service the type illustrated in our half-tone cut.



BENGAL-NAGPUR 4-4-2.

In Austro-Hungary, the Prairie type made its debut some time ago. Herr Golsdorf has now designed a very handsome 2-6-2 express engine for the Kaschan-Oderberger Railway. It is a four-cylinder compound with high pressure cylinders inside the frames, and the low pressure cylinders outside. The leading dimensions are H.P. cylinders 14½ x 28¼ ins.; low pressure 24¾ x 28¼ ins.; diameter of leading and trailing radial wheels, which have no controlling springs, 3 ft. 4¾ ins.; the diameter of the driving wheels is 5 ft. 11¾ ins.; wheelbase, leading radial to leading coupled wheel centres, 7 ft. 6¾ ins.; coupled wheelbase equally divided, 12 ft. 9½ ins.; trailing coupled to trailing radial wheel centres, 10 ft. 9½ ins.; total, 31 ft. 1¾ ins.; the boiler barrel has its centre 9 ft. 5 ins. above the rails, and contains 282 tubes, 17 ft. 9¼ in. long and 2 ins. diameter, which give a heating surface of 2,628.06 sq. ft.; firebox 147.47 sq. ft.; total 2,775.53 sq. ft.; grate area, 43.05 sq. ft.; boiler pressure 213 lbs. per sq. in.; weight of engine, empty, 61 tons 16 cwt.; and in working order 69 tons 2 cwt,, of which 42 tons 18 cwt. are available for adhesion.



GOLSDORF 2-6-2 COMPOUND FOR THE KASCHAU ODERBERGER RAILWAY.

The Victorian Railways have turned out from their Newport Works one of the largest locomotives in the Australian Colonies. It has been designed by Mr. T. H. Woodroffe, the chief mechanical engineer, and is known as the A2 type. Mr. Woodroffe's belief has always been that the greatest efficiency is to be got from simple, generously proportioned and carefully designed engines well handled, rather than by any striking departures from ordinary practice, and the new engine is illustrative of this theory. The work to be performed in the running of the Sydney Express includes many miles of 1 in 50 and like gradients, over a a curving hilly road, and a recent run by engine No. 572 with 309 tons behind the tender, proved the capacity of this machine. In the first 33 miles out of Melbourne, there is a rise of 1,115 ft., and this distance was run at the rate of 34 miles an hour (with the engine indicating 1,156 horse power) at the summit of Glenroy bank of three miles of 1 in 50, with of course no assistance of any sort. The following are the chief dimensions of the class: Cylinders, 21 by 26 ins., with 10-in. piston valves; diameter of driving wheels 6 ft. 1 in. The heating surface of the boiler totals 2,220 sq. ft., the working pressure being 200 lbs. The engine weighs 67½ tons, and the tender, carrying 4,600 Imperial gallons of water and 5 tons of coal, weighs 41½ tons.

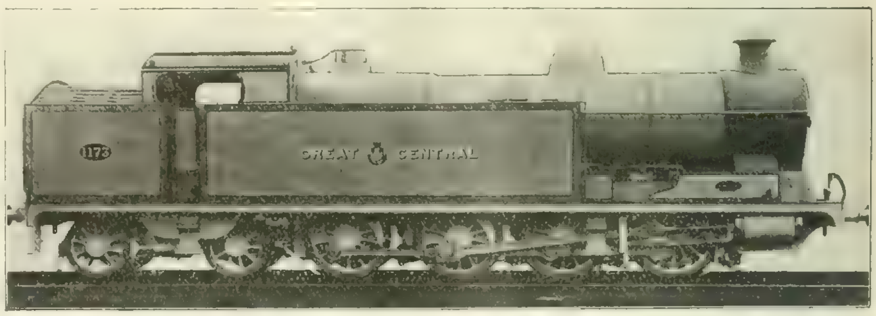
TEN WHEELER ON THE VICTORIAN RAILWAYS, AUSTRALIA.

The Commissioners of Railways, of which Mr. Thomas Tait, formerly of the Canadian Pacific, is chairman, have given instructions for the building of several more engines of this type, and these are now well in hand.

One of the most remarkable developments on the English railways is the introduction of a large 0-8-4 tank 3 cylinder engine, by the Great Central. It is intended for shunting purposes at

0-6-2 TANK ENGINE FOR LOCAL TRAFFIC.

Bath. The maximum gradient in their new concentration yard is 1 in 146, and the engine is required to push trains of 80 loaded wagons, weighing approximately 1,200 tons, up this gradient to the summit, whence they descend by gravity on the other side into the sorting sidings. In order to meet this demand, and at the same time keep so powerful a locomotive within the limits of interchangeability which tends to economy in locomotive construction and working, Mr. J. G. Robinson has adopted for the new engine the wheels, axles and axle-boxes, coupling and outside connecting rods and motion, of his eight-coupled mineral engine, and the standard boiler as supplied to his Atlantic type of express engine. He has, however, made an important innovation in the introduction of a third cylinder between the frames, all three having a common diameter of 18 ins. with a stoke of 26 ins., but here again he has simply utilized a single cylinder and motion identical with those fitted to his standard six-coupled goods engines. The inside crank on the second axle, and the two outside crank-pins on the third axle, are set at angles of 120 degs., thereby securing an almost ideal turning moment, when giving a maximum tractive effort. The frames are extended well behind the footplate,

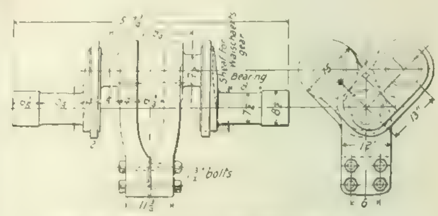


THREE-CYLINDER SIMPLE SWITCHING ENGINE.

giving a large coal bunker and rear tank, in addition to the two large tanks at the sides of the boiler and firebox, the rear portion being supported on a four-wheel bogie. The heating surface is 1,931 sq. ft. in all of which the tubes supply 1,777.9 and the firebox 153.1 sq. ft. The axle load for the drivers is 18 tons 7 cwt. for the leading pair and 18 tons 13 cwt. for the two rear axles. The total weight of the engine is 96 tons 14 cwt. The tank carries 3,000 Imperial gallons of water and 5 tons of coal. The calculated tractive effort of this engine with three simple cylinders is in the neighborhood of 40,000 lbs.

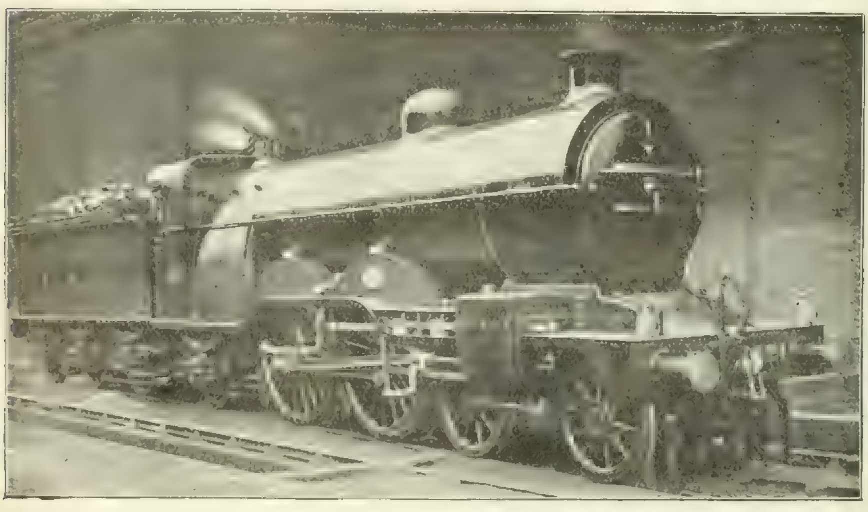
The Great Northern Railway of England have just put into service a number of new 0-6-2 side tank engines for local traffic, a view of which we give. This engine has cylinders 18 x 26 with 5 ft. 8 in. drivers. The tank carries 1,600 gallons of water and 4 long tons of coal. The total heating surface is 1,249.8 sq. ft.

This road has also built at Doncaster a new four-cylinder compound express having the following leading dimensions: H. P. cylinders 13 ins. by 20 ins., low pressure 18 ins. by 26 ins., operated by Walschaerts valve gear. The leading coupled crank axle is of a built-up, balanced type patented by Mr. H. A. Ivatt, an illustration of which we give. The boiler is somewhat modified from that hitherto standard on the larger Atlantics, the smokebox being extended backwards instead of in advance of the chimney. Consequently, the distance between the tube-plates is reduced; the total heating surface is 2,351.8 sq. ft., of which the firebox contributes 143.6 sq. ft., and the tubes 2,208.2 sq. ft.; the grate area is 31 sq.



BALANCED CRANK AXLE MADE IN TWO PARTS.

ft. The total weight is 69¼ tons, of which 36 tons are on the coupled wheels. This is a very brief synopsis of what is being done abroad in the various countries in the matter of locomotive design. Many of these show a marked degree of originality, and the way the solution of the problems presented has been worked out is interesting.



GREAT NORTHERN 4-4-2 WITH BALANCED CRANK AXLE.

Applied Science Department

Elements of Physical Science.

XVII. Electricity.

Electricity is a mode of force acting on matter the molecules of which it polarizes, or arranges in a definite direction. Electricity may be developed by friction, by chemical action, by magnetism and by heat. Friction is the commonest source of electrical excitement. It may be readily noted that, if a dry glass tube or a stick of sealing-wax be rubbed with a piece of flannel and then held a short distance above some shreds of cotton, they will be immediately attracted to it, and after adhering to its surface for a moment they will be thrown off. If the tube or sealing-wax be presented to a metallic body in a dark room a spark of fire, accompanied by a sharp cracking sound, will be seen darting from it to the metal.

This force is what is known as electricity. Experiments readily determine the fact that there are two kinds of electrical excitement, which are distinguished as positive and negative. As a general law it may be observed that substances charged with opposite electricities attract each other, while those charged with like electricities repel each other.

The cause why one body when excited becomes positive and the other negative has not been discovered. It requires experiment to determine what kind of electricity a body will exhibit. It is a remarkable fact, that the same body exhibits different kinds of electric force when rubbed by different substances. Polished glass is positively electrified when rubbed with flannel, but becomes negatively electrified when rubbed on the back of a cat. Rough glass becomes negatively electrified when rubbed with flannel, but positively when rubbed by dry oiled silk.

All bodies can be electrified, but not with equal facility. Electricity is confined to the surface of an excited body and does not in any way affect the interior. This is readily proved by electrifying a hollow sphere which will contain as much electricity as a solid ball of the same size. Substances that transmit electricity freely are called conductors, those that do not, non-conductors. Some of the principal conductors are the metals, silver and copper being among the best. Among the principal non-conductors are india-rubber, shellac, amber, glass, leather, wood, air and gases generally.

Good conductors, when brought in contact with excited bodies, draw off their electricity, and transmit to all parts of their own surface. Good conductors do not retain electricity communicated to them, but merely serve as a highway for its passing to other bodies. The best non-conductors are called insulators, because they cut off the communication with such objects as would withdraw the electricity from the body through which it may be passing. The atmosphere is a perfect insulator, otherwise no body could remain electrified for an instant. Excited bodies even when insulated will slowly part with their electricity. Moisture in the air acquires a conducting power, so that damp weather affects the insulation of electricity.

Experiments on the velocity of electricity show that on the best conductors a speed of about seven and a half times around the earth in one second can be made. Indeed the velocity with which electricity travels along the best conductors may be said to be inconceivable. It equals the velocity of light which can be much more readily measured than the speed of electricity.

Electricity is also developed by chemical action. Every chemical compound seems to consist of a positive and negative element, held together by electrical attraction. The simplest and most common development of chemical action with electricity is to be found in the immersion of zinc and copper plates in water in which sulphuric acid has been mixed. If the two plates are connected by a copper wire the water is decomposed into its elements, oxygen and hydrogen. The oxygen combines with the zinc, for which it has a strong affinity, and forms oxide of zinc, while the hydrogen appears about the copper in the form of minute bubbles of gas. The zinc parts with its positive electricity, while the copper becomes positively electrified.

It may be said that dynamic electricity is far more intense than that produced by chemical action, and is far greater in quantity. In recent years the application of electricity as a motive power has made much progress and especially in the field of transportation applied to densely populated districts. Our readers will scarcely require to be informed that in this important adaptation of electricity the pages of Railway and Locomotive Engineering furnish an interesting department that is keeping pace with the progressive spirit of the age.

The series of articles on the Elements of Physical Science that began early last year and have been continued up to the present time closes with the present issue.

Science Applied to Everyday Things.

A very clever adaptation of one of the properties of what is called spongy platinum has been made use of in the form of a cigar lighter or a gas lighter without matches. The property of this spongy platinum which makes the cigar lighter efficacious is its ability to condense upon its surface the vapor arising from liquids and to condense particles of a gas with which it comes in contact.

This ability to condense vapor on its surface is common to almost every solid substance, but varies in degree in different solids. Charcoal is a good example of a solid body having the power of condensing vapors in a very marked degree. Porus charcoal exposes a very large surface to the vapor, and consequently on account of its comparatively large internal and external area it condenses a relatively large quantity of vapor. This property is made use of especially where disagreeable smelling gases are dealt with. The condensation of different gases on or within the pores of the charcoal follow very closely the order of their solubility. Ammonia gas, which is very soluble in water, is most readily absorbed by charcoal.

Platinum in the spongy form, or platinum black as it is also called, has this property very highly developed, as for any given bulk of spongy platinum its porous nature enables it to present a comparatively large area for the condensation of vapor. Spongy platinum, or platinum black, is platinum in a very finely divided state, and may be obtained when platinous chloride is dissolved in a strong solution of caustic potash, adding alcohol to the hot solution in a large vessel and stirring. Platinum will then be deposited as a very spongy, porous black soot. This must be washed very thoroughly with alcohol, caustic potash solution, hydro-chloric acid, and lastly several times with pure water.

In the finely divided or spongy state platinum black has the property of absorbing many times its own volume of hydrogen gas and oxygen gas, and when these are condensed in the minute pores of the spongy platinum they chemically combine, and their chemical union generates so much heat that the platinum is rendered hot enough to glow, and the gas takes fire and burns, just as very finely divided iron filings burn when dropped into pure oxygen gas.

The principle here involved was made use of in Döbereiness' lamp, which was

an arrangement by which a minute spray of hydrogen was driven against some spongy platinum and with the oxygen of the air both were condensed on the surface of the metal. The heat generated by their chemical union causes the metal to glow, and this was followed by the ignition of the gas. The vapors of gasoline, alcohol and common illuminating gas will do the same as hydrogen, and the cigar lighter is a clever and interesting little device, which makes use of the same principle as was previously used in Döbereiness' lamp.

The cigar lighter of which we write is a double cylinder of thin nickel-plated metal, pocket size, arranged like the high and low pressure cylinders of a Vauclain compound. When you pull off the cap you expose a small cylinder lined with wick in which some Columbia spirit has been absorbed. The cap also contains a brass cage which just fits the hollow in the circular wick, and within this protecting cage there are four minute wires of spongy platinum. When the cage is inserted within the wick and drawn slowly out the minute filaments of platinum glow and the vapor issuing from the wick takes fire and burns with a pale blue but very hot flame. The little platinum wires, however, do not glow until drawn out level with the top of the wick, as the presence of oxygen is necessary to generate the required heat and the oxygen of the air is always present. The wick being simply saturated, there is no spirit to spill out of the little lamp, and the flame can be readily used to light a cigar or pipe.

As the protecting cage, containing the filaments of platinum black, is pushed down into the lighter, the platinum wires are surrounded by the circular wick, and they are thus bathed in the vapor of Columbia spirit. The platinum filaments are each about one-half inch long, and there are four of them, so that, minute as they appear to the eye, yet being porous they present a very large surface for the condensation of the vapor in comparison to their size. The platinum wires are coated with, and the pores penetrated by, the vapor of the spirit, and each particle of vapor as it forms on and within the spongy platinum is in an exceedingly finely divided state. As the cage with filaments is drawn out they are met by the oxygen of the air at the top of the wick. The oxygen is reduced to an extremely fine state of division as it penetrates the pores of the spongy platinum, already filled with another finely divided gas, for which the oxygen has a chemical affinity. The union of these two develops heat, which shows at once by the bright glow of the slender platinum wires, as the heat so generated causes the gases to burn in a clear, blue, smokeless flame. The little cigar lighter is perhaps more or less of an interesting toy, but it is nevertheless an example of the function of science in the adapting means to an end. One of the laws of nature has here been appealed to, and it operates as surely in small things as it does in large. The wires of spongy platinum in the hands of applied science is responsible for the tiny lambent flame.

Celebrated Engineers.

XI. George Stephenson.

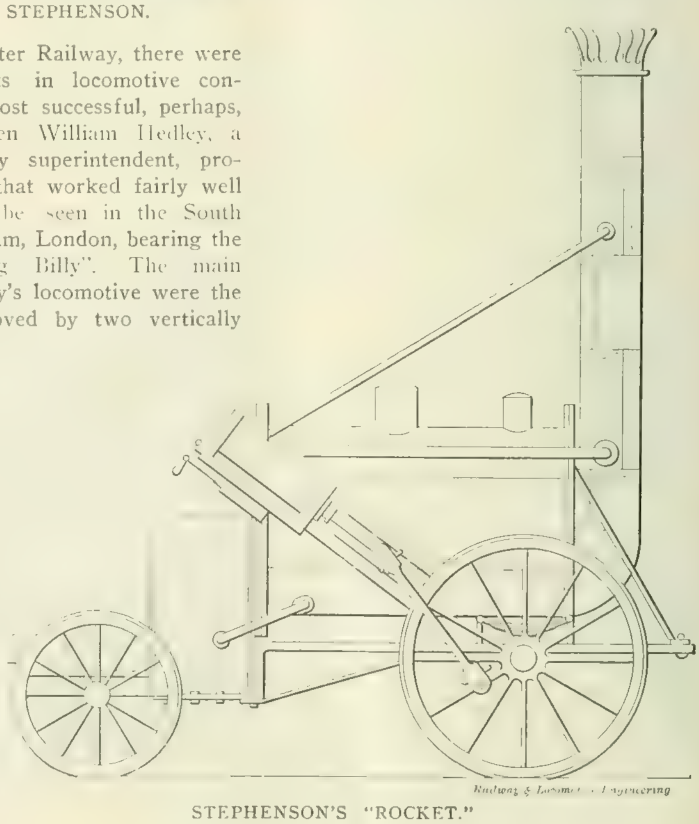
From 1803, when Trevethick's high pressure locomotive made its appearance, until 1830, when the "Rocket" was triumphantly projected along the Liver-

GEORGE STEPHENSON.

pool and Manchester Railway, there were many experiments in locomotive construction. The most successful, perhaps, was in 1813 when William Hedley, a Newcastle colliery superintendent, produced an engine that worked fairly well and is now to be seen in the South Kensington Museum, London, bearing the name of "Puffing Billy". The main features of Hedley's locomotive were the double beams moved by two vertically driven pistons. It was literally two of Watt's engines set on wheels, and from the appearance of the lofty beams it got the name of the "grasshopper" type of engine.

George Stephenson, the builder of the "Rocket," occupies a unique position in railway history. The appearance of his type of locomotive demonstrated beyond question the adaptability of steam as the motive power of transportation. His history is peculiarly interesting as showing how earnestness of purpose, wisely guided, overcomes seemingly insuperable barriers. He was the son of the fireman of a colliery engine in the neighborhood of Newcastle, England, and grew up literally without any education. At eighteen he could not even read, but his work in the collieries had brought him in contact with Watt's engine, and he began attending a night school with a view to acquaint himself more fully with the steam engine. His improvement was rapid and with a natural bent for mechanics he soon secured a position as engine-wright. He turned his attention to the locomotive. He made several experiments producing his first engine in 1814, and continuing to improve on it he was the first that gave serious attention to the important subject of locomotive roadways. He foresaw that it was necessary that the roads should be as nearly level as possible. In 1822, he succeeded in impressing the projectors of the Stockton and Darlington Railway with the advisability of using steam locomotives on their road which had been constructed with a view to using horses. So struck were the owners of the railway with Mr. Stephenson's earnestness and ability that he was appointed engineer of the railway with liberty to carry out his own plans. In 1825 the road was successfully opened and passengers and goods were carried regularly by his locomotives.

The success of this railway led to the



STEPHENSON'S "ROCKET."

projection of the Liverpool and Manchester railway. Stephenson was appointed as chief engineer and in the face of much opposition not only successfully completed the construction of the road, a most difficult and costly undertaking, but produced a locomotive so far surpassing every other attempt at locomotive construction that it may be truly said that at the close of the century marking its appearance little modification or improvement has been made on Stephenson's locomotive. The success of his engine lay in the simplicity of its parts. Trevethick's engine was cumbered with a series of ponderous toothed wheels, while Hedley's "Puffing Billy" had a top-heaviness which on the rough and uneven roads was an element of real danger. Both were costly and cumbersome and subject to frequent fractures. Both were the work of clever inventors, but neither was commercially successful.

There was no inventive quality displayed in Stephenson's locomotive. It was a masterly combination of the best elements of all that had gone before. As an inventor he is not to be spoken of in the same breath with many who had gone before him. As an engineer working among the material already on hand, and profiting by the best work of others he was of surpassing ability. He improved the tramways, he shaped the rails, he used a multitubular boiler, he abolished intermediate gears and walking beams and attached the piston to a main rod connecting to a crank on the driving wheel. He saw the utility of leading the exhaust steam up the chimney thus superinducing a rapid combustion and a correspondingly intense heat in the fire box.

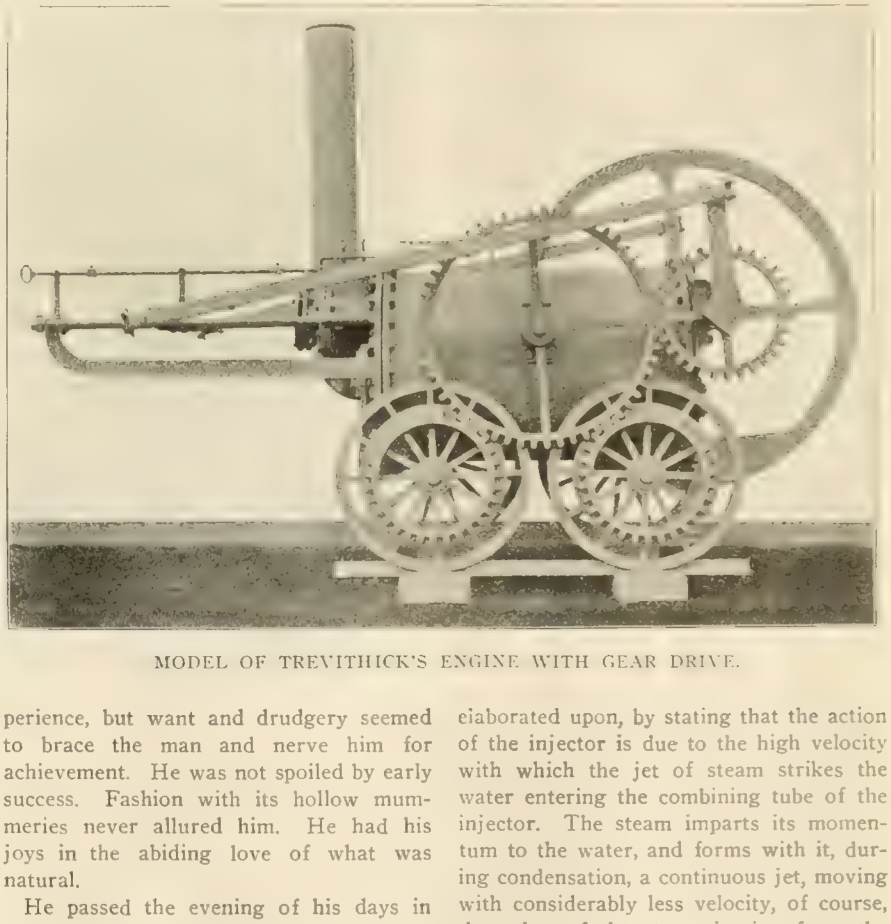
It is interesting to note that the general public were early alive to Stephenson's ability. In 1815 he was presented with £1000, as a mark of public admiration for the services he had rendered to mankind. A safety lamp for use in mines which he had perfected gained him much popular favor and the money which its general use brought to him he wisely used in perfecting his locomotive. It seems incredible when the gifted engineer was thus making his way into popular favor and preparing a machine that would revolutionize the traffic of the world, many of the members of various City Councils were devising means to stop the beneficial progress of the great work. The opposition to Stephenson's work could scarcely be believed in our days. At the meetings of the Parliamentary Committees the fine figure of George Stephenson, manly, eloquent and earnest, was an element of impressiveness that would not down. Like George Washington in the American Revolution, he had a patience that never wearied, a fortitude that disaster could not quench, a courage that kindled hope in others, and a vision of prophetic clearness rarely given to humanity.

It must have been an inspiring spectacle on that memorable day in September, 1830, when the projectors of the Liverpool and Manchester railway held a competition in locomotives running on their new road. The distance was 29 miles. There were four competitors and Stephenson's "Rocket" was the only one that completed the distance. Stephenson ran the engine himself, at a speed exceeding thirty-five miles an hour.

Henceforth honors and emoluments came thick upon him. By the time he was fifty years of age he was either acting or consulting engineer in many railways. He established nearly all of the railways in England and many on the continent of Europe. Many of his locomotives were sent to run on the first railroads in America.

His life was altogether an ideal one. From the very humblest origin he passed through the hardest kinds of human experience, but want and drudgery seemed to brace the man and nerve him for achievement. He was not spoiled by early success. Fashion with its hollow mummeries never allured him. He had his joys in the abiding love of what was natural.

He passed the evening of his days in retirement as a country gentleman, beloved by everybody. He quietly declined many public honors that were offered to him. He seemed to take his greatest pleasure in the contemplation of the beautiful in nature. He was a great lover of flowers and his private gardens were said to be wonderful. He was altogether one of nature's noblemen, a delightful character, in brief as Shakespeare says of one of the poet's noble creations,—"His life was gentle, and the elements so mixed in him that nature might stand up before the world and say, 'There was a man!'"



MODEL OF TREVITHICK'S ENGINE WITH GEAR DRIVE.

Questions Answered

THEORY OF THE INJECTOR.

(58) A correspondent writes us: Will you kindly have the makers explain their pressure theory of the working of the injector in some number in the near future? Your article in June number regarding the theory of operation of the injector is very good, and I should also like to see the other side of the story in print —A. We do not exactly understand what you mean by the other side of the story. We, however, submitted your question to a prominent maker of injectors, viz.: The Nathan Mfg. Co., and they wrote us as follows: "We beg to state that the explanation of the action of the injector in the June number of your paper is perfectly correct. The same might be somewhat elaborated upon, by stating that the action of the injector is due to the high velocity with which the jet of steam strikes the water entering the combining tube of the injector. The steam imparts its momentum to the water, and forms with it, during condensation, a continuous jet, moving with considerably less velocity, of course, than that of the steam issuing from the steam nozzle, but with considerably higher velocity than that at which the water would issue from the boiler if an opening, shaped like the delivery tube of the injector, were connected to the boiler. The difference between the velocity of the moving jet, passing through the nozzles, and that at which water, at the operating pressure, would issue from the boiler, is sufficient, not only to deliver the water into the boiler against the boiler pressure, but to deliver it against a pressure of 25 to 75 lbs. higher than the boiler pressure, varying with the

pressure, care in designing of the injector and condition of the same. The remarks contained in the June paper, concerning the maintenance and care of the injector, we can only approve of as deserving the attention and consideration of enginemen using injectors.

SACRIFICING THE BACK MOTION

(59) J. O., Mankato, Minn., writes: We have a ten-wheel passenger engine, 20 x 26 in. cylinders, piston valves, outside lap, 1 in. inside cleaners, ½ in. valve travel, 5¼ ins. forward motion set ⅛ in. blind in corner. Back-up motion set ½ in. blind in corner. What effect does the back up eccentric produce being set ½ in. blind, on the go ahead, when the engine is hooked up on first notch from the center going ahead, and what is meant by sacrificing the back-up lead for the go-ahead, and to what extent does this affect the go-ahead and why?—A. You will find this matter fully dealt with in an article in this issue entitled "Correctives in Link Motion."

CONCERNING OIL AS FUEL.

(60) Subscriber, Mexico, Mex., writes: (1) How can an engineer tell when front end is properly adjusted on both coal and on oil burner?—A. With coal the proper adjustment is apparent when fire burns evenly all over the box and the generation of steam should be good. With oil the result of the adjustment is not so apparent, as the oil flame does not need to be stimulated in the same way as that of coal, but it should be such that the hot gases will be drawn evenly through all the flues. This can be ascertained by noticing if there is more deposit of soot in one lot of tubes than in another.—(2) What color should oil fire be when combustion and draft are perfect?—A. Color of fire should be light lemon. When not perfect? A. Generally red.—(3) Will oil fire be same color irrespective of kind of oil used?—A. Yes.—(4) What will indicate too much or too little air through the draft pan?—A. Change in color of flame.—(5) How can one tell whether burner is too high or too low?—A. When burner is too high the flame generally impinges on the crown and side sheets, causing radial stays, crown bolts and stay bolts to leak. A burner should never be set over 10 ins. from the floor of the fire chamber, and the fire chamber should be as low as the construction of the engine will allow. When burners are too low the oil drips on floor of fire chamber, carbonizing there and causing engine to smoke and steam poorly. Practical experience has demonstrated that the best results have been obtained when the burner is from 6 to 8 ins. from the floor of the fire chamber.—(6) What causes the drumming sound sometimes heard in oil burning engines which are not steaming well, other than the use of too much or too little atomizer?—A. The drumming of oil burning locomotives is caused by faulty construction of brick work in fire box, careless handling of oil valve by fireman when engine is working slowly, or too great a volume of air passing through dampers.—(7) What kind of fuel oils are used on the Southern Pacific and on the Mexican Central Railways? What are these oils composed of? Are they crude or refined to some extent? and about what do they cost per gallon placed in engine tank ready for use?—A. The Southern Pacific Co. uses a Kern River oil which runs from 14 to 16 gravity. They are composed mostly of hydrocarbons containing besides a little oxygen, sulphur and nitrogen. Carbon equals 82.45, hydrogen 11.18, balance oxygen, sulphur and nitrogen. They are crude oils. They cost per barrel of oil of 42 gallons, delivered to engine, 45 cents. The oil used on the Mexican Central Railroad is a much lighter grade of oil than that used on the Southern Pacific.

POSITION OF SADDLE PIN.

(61). J. G. T., Lancaster, Ohio, asks: Please inform me how to find point of suspension on link saddle, or distance from center of link to center of lifter pin or saddle. How does it affect valve travel, and when does it produce the greatest effect, in full stroke, or cut-off, and why? I have given this some thought but fail to solve it to my satisfaction.—A. You will find this matter very fully dealt with in an article in this issue entitled "Correctives in Link Motion."

BLOW IN ONE EXHAUST.

(62) M. B., Sen Haven, Pa., writes: I am a locomotive engineer, and have a question to ask about an eight-wheel connected Long John engine that not only puzzles me but other engineers. The question is this: What is the trouble with a locomotive that has a blow in one exhaust only, the other three exhausts clear and square and the blow is noticed only when in full stroke in starting train, but after the engine is cut back the blow does not exist. Engine has the same blow in back motion. A.—This is one of those defects which can only be definitely ascertained by careful investigation. If it occurs in only one engine of a class, and not always in that case, it is probably due to the valve being cocked at one end of the travel by binding in the yoke. If, however, it occurs in more than one engine it is possibly due to something in the design of the motion, or the valve seat may be rather short, and the half travel long on one end.

The Grand Trunk Pacific, according to recent returns, now owns six thousand freight cars, which are being delivered from the East at the rate of twenty-five a day. They have also one hundred locomotives, all made in Canada, and seventy-five of them are in the West at the present time. There is a train of thirty new passenger coaches in Montreal ready to pull out for the West whenever they are wanted. Advices received at the headquarters indicate that satisfactory progress is being made on the line both East and West. In the West, where the work is under the direct supervision of the G. T. P. Company, the work is going ahead speedily. The contractors on the first 50 miles from Prince Rupert east have the right of way well cleared.

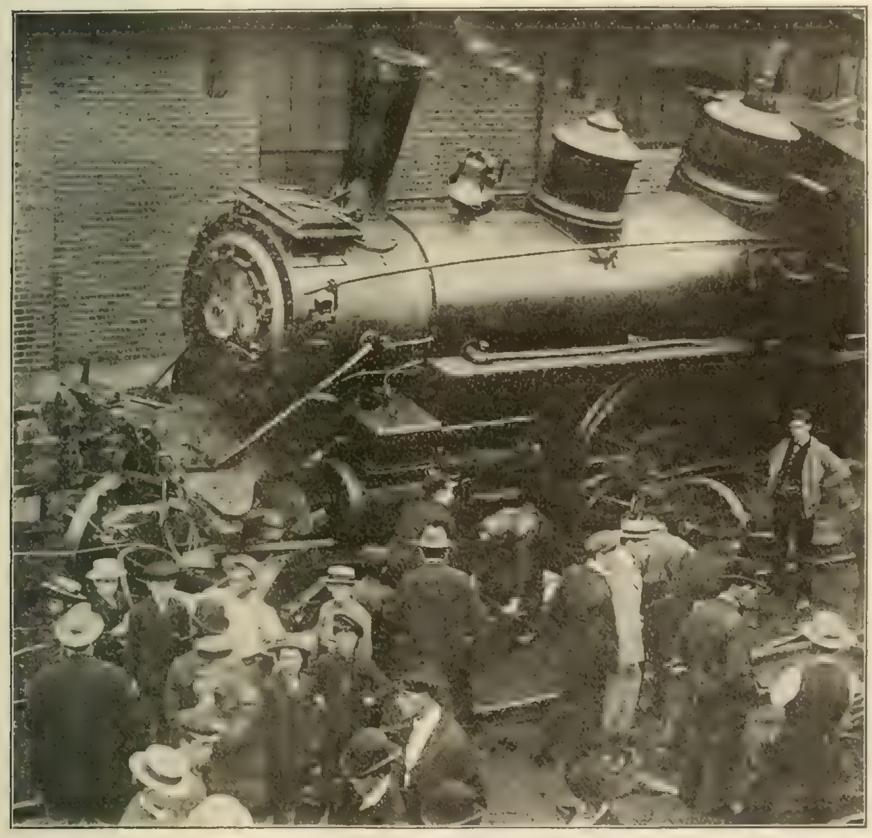
RED SANDSTONE CLIFFS AT HOPEWELL CAPE ON INTERCOLONIAL RAILWAY OF CANADA.

Continued reports from the German railways agree that excellent results are being obtained in the use of superheating appliances on locomotives. A concensus of these reports would show that a saving in fuel amounting to 15 per cent. is made. The reports of the cost of the appliances and the maintenance are of the most meagre kind; but it is claimed that the life of the apparatus would be equal to that of the locomotive.

Air Brake Department

Broken Air Pipes.

In an article on this subject recently published in these columns it was stated that the subject would be continued, and it will be the object of this article to explain how the brakes on a train of cars can be operated from a locomotive equipped with the New York Air Brake Company's B² H. S. equipment when the brake valve branch of the brake pipe is broken between the brake pipe and the connection to the high-speed controller valve and how the brake can be operated should the brake valve itself be broken.



MISPLACED SWITCH DID IT.

If the brake valve branch is broken off from the brake pipe when out on the road the handle can be placed on lap position and both ends of the break plugged, care being taken not to obstruct the flow of air through the brake pipe, the stop cocks to the brake cylinders can then be closed and if there are stop cocks to the auxiliary and truck brake reservoir they should also be closed.

The triple valve can then be taken apart and the triple valve piston removed, the back cap and gasket replaced in their proper position and the triple exhaust port plugged, which will establish a communication between the brake cylinder pipe and the brake pipe and prevent the escape of air at the triple exhaust.

The piston should then be removed from the double check valve and the pipe again connected up, and the adjusting nuts on the straight air reducing valve and the highspeed controller should be screwed down to create a greater tension on the springs than the brake pipe pressure to be used.

If these parts can be reached when the locomotive is out on the road this work can be done in a very few minutes' times and it may take several hours to secure another engine to haul the train.

If it can be done at all it can be done as quickly as most any other breakdown on a locomotive can be handled out on the road and when done the brake valve handle can be placed in release position and air will flow from the brake valve through the straight air reducing valve, double check valve and the triple valve into the brake pipe on the engine and train. The adjusting nut of the reducing valve is screwed down to prevent it from closing when 40 lbs. pressure is attained in the brake pipe, the duplex controller will govern this pressure.

The safety valve adjusting nut on the high-speed controller is screwed down to prevent it from exhausting brake pipe pressure when it reaches the figure for which the controller safety valve is adjusted. When it is desired to apply the brake the valve handle can be placed in running position and brake pipe pressure will flow from the brake pipe through the triple valve, brake cylinder pipe, double check valve, straight air reducing valve and the brake valve to the atmosphere applying the train brake. The flow of air through the triple valve would not be free enough to apply the brake in quick action, but when the shortest possible stop is desired, opening the lever on the high-speed controller would have a tendency to assist in reducing brake pipe pressure. The stop cocks to the reservoirs are closed so that their volumes are not added to the brake pipe volume.

BROKEN BRAKE PIPE IF THE TENDER IS EQUIPPED WITH THE COMBINED AUTOMATIC AND STRAIGHT AIR.

If the tender is equipped in this manner and the standard ¾ of an inch hose are used to connect the tender and driving brake cylinders, sometimes the standard brake pipe hose are used by bushing the angle fitting to ¾ of an inch, in either case if the brake cylinder pipe at the rear of the engine can be connected with the brake pipe on the front of the tender, this connection can be made in case of any broken brake pipe on the engine.

If the brake pipe is broken anywhere below the high-speed controller connection or anywhere above it, it will only be necessary to plug the break toward the brake valve, the rest of the brake pipe can be removed from the engine, but if the controller is also broken off the break must be plugged.

It will then only be necessary to cut out the driver brake triple valve, close the stop cocks to the driving brake cylinder, leaving the cock in the pipe to the tender cylinder open and when the connections between the engine and tender are made, placing the brake valve handle in release position will charge the train brake pipe through the engine brake cylinder pipes, and placing the handle in running position will reduce the pressure in these pipes and apply the brakes.

As in other cases the adjusting nuts on the reducing and controller valves must be screwed down to fully charge the brake pipe and prevent the escape of

air. The lever on the high-speed controller can be used to assist the brake valve in cases of emergency.

BROKEN BRAKE VALVE.

Should the brake valve become entirely disabled, such as the connecting link breaking or becoming disconnected, the valve handle broken off, the valve body broken or both the main reservoir and brake pipe breaking off, the brake pipe could be charged by closing the reservoir cut out cock and the stop cock under the brake valve and removing the supply valve from the signal reducing valve and connecting the brake and signal pipes on the pilot as with a broken reservoir pipe.

The brake would be applied by opening the stop cock under the brake valve and released by starting the pump. In cases of emergency the pump can be stopped afterward. The stop cock in the signal pipe at the rear of the tender should be closed and the pump governor can be adjusted to 110 or 70 lbs.

TRIPLE VALVE BROKEN OFF.

Any broken pipes about the triple valve can be handled in the usual manner, but with this equipment the absence of the triple valve would not destroy the driver brake.

Moving the handle to release position will apply the driver brake with any degree of force desired and admit no reservoir pressure to the brake pipe passing the handle on to the graduating positions will apply the train brakes promptly.

BROKEN SUPPLEMENTARY RESERVOIR PIPE.

If the pipe connecting the supplementary or small end of the divided reservoir to the brake valve should become broken or disconnected we would plug the connection at the brake valve, then, in service applications, lap the brake valve by hand, returning the handle slowly to positive lap position after the required reduction in brake pipe pressure has been made. By breaking this pipe connection we would only lose the automatic lap feature of the brake valve.

Should the pipe connecting the accelerator valve be broken off, it would only be necessary to stop the brake pipe leak and the accelerator valve could no longer assist the brake valve in brake pipe reductions.

Should the brake cylinder pipe be broken at a point between the double check valve and the high-speed controller the broken piece from the check valve must be plugged in order to retain the brake cylinder pressure during applications of either the automatic or straight air, and in order to prevent the possibility of wheel sliding, the union 3-way cocks in the governor and duplex pressure controller pipes can be reversed, which will set the low-pressure brake.

Should a break occur in the pipe connecting the brake valve branch with the high-speed controller it would only be necessary to plug the brake pipe leak, the safety valve would still be operative and would reduce the high brake cylinder pressure developed during emergency applications promptly, instead of gradually reducing pressure to the figure for which it is adjusted. If the break is between the brake valve branch and the Tee, to which the duplex air gauge is connected, the hand of the gauge will not register the brake pipe pressure.

SIGNAL BRIDGE USED ON THE PENNSYLVANIA.

Should the pipe connecting the reducing valve with the double check valve be broken the stop cock in the pipe leading from the brake valve to the reducing valve would be closed which would cut out the straight air brake without interfering with the automatic brake. Should

TIE AND TIMBER CAMP, APAPASCO MOUNTAINS, SAN RAFAEL & ATLIXCO RAILROAD.

the pipe connecting the brake valve and the accelerator side of the divided reservoir be broken there would be no leak to plug, but the accelerator valve would be inoperative as the pressure used to operate the controller would escape through the break.

The broken gauge pipe, governor pipe or high-speed controller pipe have the same effect as with the older equipment, rendering inoperative the parts to which they are connected and must be plugged to prevent a waste of air. The main reservoir equalizing pipe is 1¼-inch pipe and when broken it is usually an engine failure and at such times it is also well to remember that the thread on the air hose nipple is also a standard 1¼-inch and if the broken parts of the pipe can be removed from the fitting into which they are screwed very often two brake hose can be used to make a connection. The reservoir pipe is also 1¼-inch pipe and the same thing applies to this pipe the 1¼-inch air brake hose will screw into any Ell, Tee, socket or union swivel in this pipe or in the equalizing pipe between the reservoirs.

If the foregoing has been followed closely it may also occur to the reader that it may be possible, under certain conditions, to operate the train brakes from the engine even if the equalizing pipe between the reservoirs is broken and no connection can be made.

To dream through the hour that should be filled with doing is one of the snares and delusions in life. When a noble or clever deed is announced as accomplished, what a chorus goes up to the tune of "I thought of that years ago!"—*S. S. Times.*

Electrical Department

Short Circuits.

By W. B. Kouwenhoven.

A short circuit is the name applied to the circuit produced when a connection of low resistance is accidentally formed between electric wires, which are at different potentials. As the name implies, the circuit thus formed offers a short path for the passage of the electric current. A short circuit permits an instantaneous rush of current from one wire to the other, and the value of this current is usually very great. They are not always accidental but they are usually so.

Short circuits that are liable to happen on a railroad employing the third rail as a power distributor are of numerous varieties and a consideration of a few of the more common ones is interesting. A "short," as it is sometimes known, may be caused by the dropping of an iron tool or a piece of wire so as to form a contact between the third rail and the track; by the wearing away of some portion of the insulation; by a derailed car tearing up the third rail and bringing it in contact with the track; and in many other ways.

The conditions of two wires between which there exists a difference in voltage is similar to two bodies of water at different levels, the body of water at the higher level being separated from the body of water at the lower level by a wall or dam. The difference in heights or the difference in pressure between the two bodies of water corresponds to the difference in voltage between the two wires. The terms pressure and voltage are analogous in their meanings. The dam separates or insulates one water level from the others, and in the same manner the coverings and the air space between the wires separate or insulate them from each other.

When a wrench or some other tool falls so as to form a contact with the third rail and the track or structure, there is an instantaneous rush of current. If the wrench be small in cross section the enormous current will quickly bring the metal to its melting point and the hot metal will be thrown about thus interrupting the short circuit. This kind of short circuit corresponds to knocking a very small hole in the dam, through which the water would instantly flow, but in which some dirt or debris might lodge and clog the hole up.

If the wrench was of large size the circuit breakers that protect that section of the track would very likely be opened. There is no doubt, however, that the wrench would be destroyed and there would be burnt spots on both third rail and the track, where the metal had been fused.

If the insulation of one of the feeders which supply current to the third rail or the insulator of the third rail itself becomes worn away by continual chafing thus allowing the feeder to come in contact with the iron structure, a very heavy current would flow through the contact thus formed. This current would heat the place of contact to incandescence and the heat would probably set fire to the structure. The circuit breakers of course would open and cut off the power supply from the section where the trouble existed.

A short circuit of this type would correspond to the gradual forming of a large hole through the dam. The water would pour through in great quantities and repairs would have to be made. In much the same manner the trouble would have to be located on the structure of an elevated road and the damaged insulation repaired and any fire that had been started would have to be promptly extinguished.

When a car leaves the track there is usually trouble ahead for the electrical circuits. The third rail and the track become tangled up and a very bad "short" is often the result. The circuit breakers cut off the power, but repairs more or less extensive would be necessary before it can be turned on again. This action of the fuses and circuit breakers in cutting off the power was described in the July issue of this paper.

Short circuits are usually unexpected and accidental as was stated before. They are dangerous in that the hot metal that is thrown about may not only set fire to the wood work in the vicinity but also workmen may be severely burned. The sudden heavy rush of current produced by a bad short circuit may form a surge and open the circuit breakers all the way back to the central station.

A very curious case of short circuit occurred some time ago on the electric wires of the Vancouver, B. C., power and light lines which supply that city. The wires from the power house are suspended high in air from lofty towers on either side of Burrard Inlet. These wires are high above the water, so that the masts of passing vessels are far below the sag of the wires. The towers are not in the vicinity of human habitation and on one occasion a little animal of the rat species climbed one of the steel towers and in the course of his unauthorized investigations, while resting on the top of the tower, put both fore paws on one of the live wires.

The body of the little animal thus formed a connection between wire and tower and a powerful short circuit was the result. The little animal was of course instantly killed in the position it had assumed, but the dead body remained where it was, and rapidly as the circuit breakers responded, the body of the small rodent was burned to a crisp and now forms one of the curiosities which the superintendent of the company shows to interested visitors who come to his office.

Three Wire System for Lamps.

The three wire system of power distribution for illumination purposes is very common and is used in many railway station platforms and other similar places. It has many advantages over the other systems of incandescent lighting. This system is also used to some extent in lighting railway shops and offices.

It is difficult to manufacture incandescent lamps for voltage above 120. Incandescent lamps are very sensitive to slight variations in voltage, their candle power varying as the fifth power of the voltage. The employment of incandescent lamps in series for electric lighting is not entirely satisfactory, due to the danger attending high voltage and to the fact that when one lamp burns out, some device must be used for shunting it, or the current will be interrupted and the other lamps will go out.

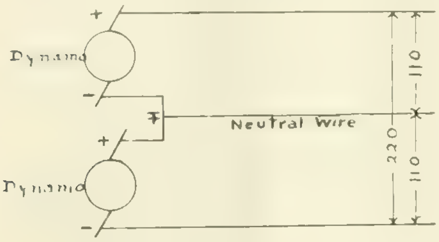
There are several methods employed for the generation of power for three wire systems, but the description of one, however, will here suffice. In this system two dynamos are employed each generating a direct currect at 110 volts. Each machine has two terminals, a positive one and a negative one. The positive terminal of one generator is connected to the negative terminal of the other, thus forming a single common lead. This lead forms the middle wire of the system and is known as the neutral or the "plus or minus" wire. The remaining terminals of the generators are led out and form the two outside wires of the system.

This gives a difference of potential of 110 volts between either outside wire and the neutral wire, and also gives a difference of 220 volts between the two outside wires.

There is no direct analogy to this system in the mechanical field, but one may liken it to an imaginary hydraulic pumping system, where pumps provide water

for small water wheels, the same water being used over and over again. Suppose that there are two pumps each capable of delivering water at a head of 100 ft., each pump having a delivery pipe and a suction pipe. The delivery pipe corresponds to the positive terminal of the dynamo and the suction pipe to the negative terminal.

The delivery pipe of one pump is attached to the suction pipe of the other,



PRINCIPLE OF THE 3-WIRE SYSTEM.

and a pipe line is run out from this junction. This pipe line corresponds to the neutral wire of the three wire system. The remaining suction and delivery pipes are also connected to two pipe lines forming the two outside lines of the system. The one outside pipe would be at a pressure of 100 ft. higher that the central pipe and the other outside pipe would be at a pressure of 100 ft. less. The difference in pressure between the outside pipes would be 200 ft. This is similar to the electric circuit.

Suppose that all the water wheels are of the same size, handling the same quantity of water and operating at a head of 100 ft. Consider at first only two water wheels. Place one of these water wheels between the outside pipe and the neutral pipe, and the other between the neutral pipe and the other outside pipe. Now the same water that flows through the first water wheel would pass on through the second and return through the suction pipe to the station. Thus two pumps could be operated with the same volume of water.

As long as there are an even number of water wheels and they are equally balanced on the two sides of the system, there would be no water flowing in the neutral pipe. If, however, they were not equally balanced, as might be the case with incandescent lamps, and more wheels were in operation on one side than on the other, only the water necessary to operate the unbalanced portion would flow back through the central pipe. Thus the middle pipe could be made smaller than either of the two outside ones, and the loss due to friction would be less because of the smaller volume of water that was used.

In a similar manner as long as the lamps are equally divided on both sides of the circuit, no current flows in the middle or neutral wire of the three wire system. It is only when the circuit is unbalanced that there is any current in the neutral wire. This current is usually very small, as an effort is usually made when the installation is planned to divide the lamps equally and thus balance the two sides of the system as far as possible.

The power loss in the wires varies as the square of the current multiplied by the resistance. Thus the three wire system by making the same current do double work, by passing first through one lamp and then through another, saves loss of power in the wires. This system makes possible the use of small feeders and so saves in the amount of copper necessary to supply the proper voltage to the lamps. It is a very satisfactory system for lighting incandescent lamps.

Traveling Engineers' Convention.

The sixteenth annual convention of the Traveling Engineers' Association was held at Detroit, Mich., August 25 to 28, 1908. There was a large attendance and the various reports read brought out some very interesting discussions. The papers were practical in character, as can be seen from their titles.

The papers were seven in number, and were: (1) How Much Territory Should a Road Foreman of Engines Cover? Over How Many Engines and Crews Should He Have Jurisdiction? (2) How Can the Road Foreman of Engines Interest Engineers and Firemen in Keeping Posted on Progress in Locomotive Developments, Including Valve Gears and Steam Distribution? (3) What Is Good Practice for Traveling Engineers Relative to Coaching and Demonstrating to Firemen Economical Methods of Firing Locomotives and Preventing the Emission of Black Smoke, and the Best Method of Interesting All Concerned in Coal Economy? (4) In What Manner Can the Road Foreman of Engines Best Assist in Increasing the Net Earnings? (5) Terminal Tests of New Types of Locomotive Brakes to Locate Defects, and Remedies for Defects. (6) Superheated Steam and the Best Method of Getting Good Results When Engines Are in Service on Trains. (7) The Influence of a Thorough Education on the work of an Engineer and Fireman as a Factor in His Success.

Master Car and Locomotive Painters

The thirty-ninth annual convention of the Master Car and Locomotive Painters' Association will be held at Atlantic City, N. J., September 8, 9, 10 and 11, 1908. The Hotel Rudolf has been selected as headquarters and arrangements have been made by the Hotel Committee for rates upon the American plan to all attending this convention.

The programme reflects credit on this years' advisory committee, for the instructive and interesting list of subjects, essays and queries it has formulated; also in its selection of the corps of members who have consented to prepare and present the papers and compositions.

There will be an increased number of essays presented this year, by gentlemen of long and practical experience in their respective lines. This is a departure from the custom followed in former years and it no doubt will be a feature that will be appreciated by all.

These papers will be interesting and instructive to members as well as to officials of railways.

All foremen and assistant foremen of railway paint shops, steam and electric, in the United States and Canada, and all others who are, in any way, interested in the good work of this Association, are very cordially invited to be present.

Work for the De Glehn Compounds.

On the Paris-Orleans Railway in France, where the De Glehn Compounds recently built at Schenectady will work, on the road coming from Brive, there is, with the exception of a few short level stretches, an almost continuous up grade averaging about ¾ per cent. for a distance of 29.5 miles, while going in the other direction, the road from Limoges to the summit of the rise is more undulating and the grades steeper but shorter, the steepest grade being about .95 per cent. and 7.14 miles long. The fastest trains weigh from 300 to 325 metric tons behind the tender, and make the run between Limoges and Brive in one hour and 29 minutes, including 16 stops, while from

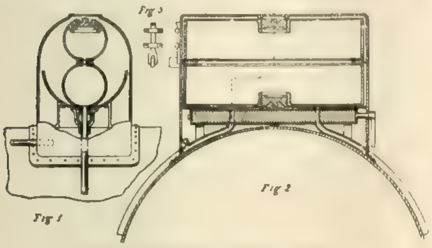
TEPATATE CUT, SAN RAFAEL & ATLIXCO RAILROAD.

Brive to Limoges, with the same weight of train, the time is 8 minutes longer. To meet these requirements a powerful engine with a large boiler and capacity for high speed has been designed, and the engines are illustrated and described in another column of this issue. The engines are intended to haul trains of 400 metric tons on a 1 per cent. grade at a speed of 30 miles per hour. The American-built Paris-Orleans De Glehn engines which will be operated over this road have a spark extinguishing device which will be illustrated in another issue of Railway and Locomotive Engineering.

Patent Office Department

LOCOMOTIVE SANDER.

An improved Locomotive Gravity Sander has been patented by C. E. Richards, Boonville, N. Y. The device embraces a pair of reversible, intercommunicating sand receptacles mounted on journals, a casing inclosing the receptacles and having a concave bottom adjacent to

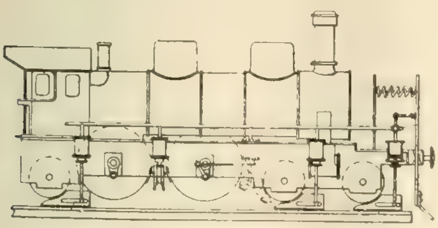


REVERSIBLE SAND BOX.

which the lower receptacle is adapted to take position. There are discharge openings in the receptacles and openings in the shield coincident with those of the receptacles, and a cut-off controlling the openings. There are also means for supplying air pressure, and the apparatus has the decided advantage of completely preventing any caking of the sand, as the receptacles may be readily reversed at any time, thereby avoiding the necessity of emptying the sand boxes before they can be put in working order.

AUTOMATIC STOPPING DEVICE.

An automatic vehicle stopping device, which may be applied to locomotives, has been patented by R. de Halmy, Dios-Gyor, Austria-Hungary, No. 893,489. The device consists of wedge-shaped blocks suspended by means of rods in front of the wheels above the rails, a cylinder and a piston in the same, a rod depending from the piston to the block, the cylinder being in communication with the atmosphere at the bottom and with a vacuum chamber at its upper end, and means for simultaneously cutting off the vacuum, and a tripper adapted to operate the means on collision with an obstacle.



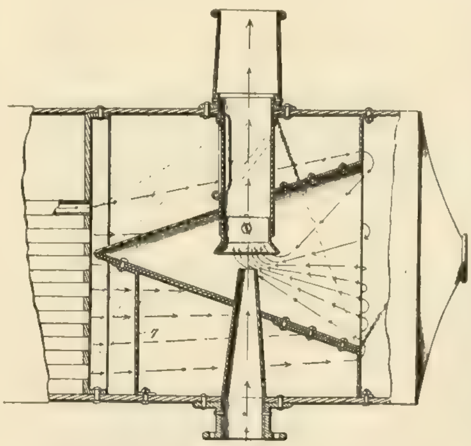
AUTOMATIC TRAIN STOP.

TRACK CLEARING DEVICE.

A track clearing device for railroads has been patented by J. A. Shires, Denver, Colo., No. 893,878. In combination with a locomotive, or other similar vehicle, the device is furnished with a nozzle mounted thereon, and occupying a position above the track rail, a spring-retained housing inclosing the nozzle, and a pipe system connected with the air source and communicating with the nozzle. A portion of the pipe system is located within the fire box, so that the air delivered to the rails is suitably heated. There is also a funnel-shaped air receiver communicating with the system at its opposite extremity, the receiver being swivelled and provided with a vane for maintaining it in proper position with reference to the direction of the wind.

DRAFT REGULATOR.

W. A. Skinner and T. P. Cain, Moberly, Miss., have patented an improved locomotive draft regulator, No. 887,278. As is shown in the accompanying illustration, the device combines a smoke-box, stack and exhaust nozzle. A funnel is constructed in the smoke-box, with its open end foremost, the exhaust nozzle projecting into the funnel. There is a draft pipe extending downwardly from the stack into the funnel above the exhaust nozzle, with an opening, and a damper hinged to the draft pipe and arranged to fall inwardly therefrom. The effect of the device is to induce an equable draft through all of the flues.



LOCOMOTIVE DRAFTING DEVICE.

LOCOMOTIVE.

George L. Wall and L. E. Feightner, Lima, Ohio, have patented a locomotive and assigned the same to the Lima Locomotive Company, No. 893,041. The device embraces a locomotive furnished with frames having cross-ties, a horizontal tubular boiler supported upon one of such frames. There are body bolsters connecting the side frames near opposite ends and provided each with a center-plate, a swing bolster pivoted under each of said center plates. There are wheeled trucks pivoted to the end center plate and free to turn thereon when passing curves.

CYLINDER VALVE.

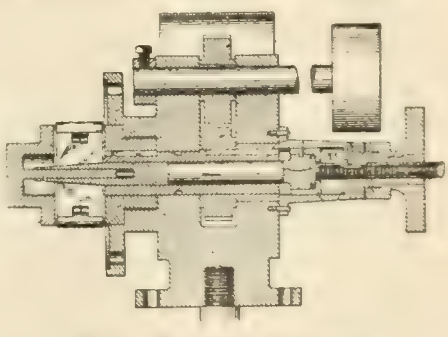
J. Manton, Clairton, Pa., has patented an automatic cylinder valve, No. 8[illegible],535. The device consists of a pair of drain cylinders having opposing heads formed with inlet nipples, and pipes for connecting the nipples together. Each

AUTOMATIC CYLINDER VALVE.

of the drain cylinders is furnished with an outlet port and also a connection engaging with the engine cylinders. A piston is mounted in each of the drain cylinders, and also a spring bearing against the piston. A fluid pressure supply pipe communicates with the pipe branch, and there are means reaching to the cab of the engine for controlling the supply of pressure.

TUBE EXPANDER.

An improved expanding tool has been patented by F. H. Cunningham, Pittsburgh, Pa., No. 892,981. The device is furnished with a rotary head, carriers moving outwardly therein, with rollers supported by the carriers. There are pins on the ends of the rollers and bearings on the carriers to receive the body of the rollers without reduction in their diameter. There are also projections on the carriers to co-operate with the pins to



FORM OF TUBE EXPANDER.

prevent the separation of the rollers and their respective carriers. A rotating mandrel moves the carriers outwardly. A screw is swivelled to the mandrel, with means for preventing the rotation of the screw, and a non-travelling nut to cause the longitudinal travel of the screw and mandrel.

Concerning the Derailment of Tenders

By F. P. Roesch, Master Mechanic Southern Railway

I was very much interested in the article on tender derailments contributed to the August number of RAILWAY AND LOCOMOTIVE ENGINEERING by Mr. W. S. Templeton, S. M. P. of the Central Railway of Guatemala. The cause of and remedy for tender derailments has been a mooted question among not only mechanical, but transportation and roadway men for years, and one on which apparently few men as yet agree.

The old saw, "What is one man's meat is another man's poison," seems to apply very forcibly in this instance. It is natural to assume that in a straight mechanical proposition, such as design and action of tender trucks under given conditions, that like causes would produce like effects, and yet apparently just the opposite obtains.

For instance, many cases have been noted where derailment of tender trucks was attributed to a certain location of side bearings. On one large system in particular the writer recalls where the side bearings had originally been placed outside of the arch bars, cessation from derailment was obtained by moving the side bearings inside of the arch bars, while upon another system operating under apparently similar conditions, on which the tenders were originally equipped with inside side bearings, derailments were attributed to this location, and the bearings moved to the outside, and strange to say, equally as good results followed the change as in the first instance.

On a certain road, derailments were attributed to lack of flexibility due to having side bearings on both trucks, and good results followed the removal of the bearings from the forward trucks, while on another road the absence of side bearings on the front truck was given as the cause of continual derailments, an argument apparently borne out by the fact that derailments ceased upon the application of side bearings all round. There are more seeming anomalies in locomotive practice than in any other mechanical art.

There is no question but that Mr. Templeton's solution of the problem as applied to the particular type of tender in vogue on his line, is eminently correct; but that the same remedy will not obtain on all roads is borne out by the fact, that we have equally as many tender derailments where the tenders are equipped with inside hung brake beams—as obtains on all modern large capacity tenders—as with tenders equipped with the outside hung beam, and therein we come into contact with another of the seeming anomalies.

And yet there is a reason for this apparently strange state of affairs, and if the real cause of derailment is determined beyond question, the mechanical inconsistencies soon vanish, and it will readily be seen that although in each case noted a diametrically opposite course was pursued to obtain relief, yet in each instance the proper measures were taken. New trucks are more prone to derailment than old trucks. This applies to both tenders and cars, but more especially to tenders owing in a measure to the shorter wheel base. As a general proposition this tendency to derailment on the part of new trucks is due principally to their extreme stiffness or rigidity. We are, however, often loath to admit this fact, and are

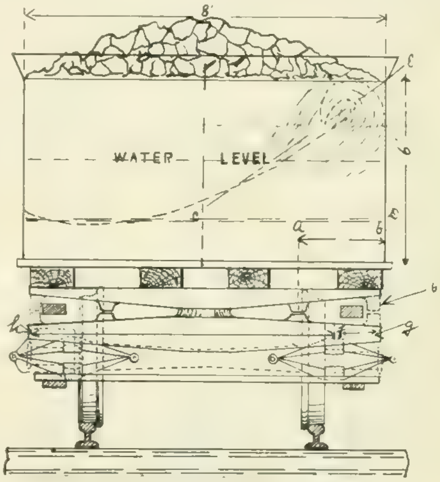


FIG. 1. REAR VIEW OF TENDER.

prone to attribute all derailments to defects in the alignment or surface of the track, and as after each derailment it is usually necessary to make some repairs to the track. We prove our assertion by the fact that after a series of derailments followed by subsequent track repairs—where derailments occurred—the derailments gradually cease.

This places us in postion to say to the superintendent or roadmaster, "What did I tell you, don't this prove that the fault all lay in the track? As soon as you picked up the rough spots the trouble ended," when the real facts were, that during all this period the trucks had been running a sufficient length of time to have become thoroughly limbered up and flexible enough to adjust themselves to any slight irregularities.

This is no argument in favor of bad tracks; the fact remains, however, that if a truck is properly designed, correctly applied, has sufficient flexibility, and the right side bearing clearance, it will adjust itself and run with perfect safety over some very uneven track. In fact, any track that is safe for a locomotive should certainly be safe for the tender.

Let us be fair and give the devil, whether he presents himself in the guise of a superintendent or a roadmaster, his full due, and not render unto Caesar what properly belongs to Antony.

To get back to our subject: Cause of derailments of locomotive tenders and the logical remedy. As previously stated, there is no doubt but that in the case mentioned by Mr. Templeton, the correct cause was ascertained and the proper remedy applied. We will now, however, look into the causes of tender derailments of the modern high capacity, steel bolster, inside hung brake beam type.

Fig. 1 is a rear view of a tender showing the section through the rear truck just ahead of the back pair of wheels, so as to show the bolsters, springs, side bearings, etc.

The view shows the tender on an even keel with cistern half full of water. The side bearings are shown in full lines and placed inside the arch bars. The point where outside side bearings would be located in case applied is shown at the extreme ends of the bolsters and in dotted lines.

Were the track perfectly straight and smooth the entire load could be carried on the center casting and the side bearings dispensed with in perfect safety. As this is a condition that does not obtain, however the side bearings are added to catch a part of the weight, as the tender strikes a curve or the truck drops into a low place in the track, and so prevents the body of the tender from being rolled clear of the trucks.

We know that as a tender enters a curve, and especially if at a high speed, that the action of the centrifugal force has a tendency to impel it at a tangent, or, in other words, to the outside of the curve; this causes a change in the distribution of the weight on the truck, due partly to the shifting of the fluid load (water) and partly to the impulse imparted to the body of the tender by the centrifugal action referred to.

The weight which on level track was carried entirely by the center casting is now distributed between the center bearing and the outer side bearing. This side bearing, therefore, in conjunction with the bolster, the spring-seat, the arch bar and the axle journal, all form a series of levers and fulcrums, all having a definite action on the stability of the truck, and which action must be traced in order to determine wherein the design is defective.

Assuming that the tender is entering a

curve of a stated radius at a certain speed. The centrifugal force has a tendency to impel the tender forward in a straight line instead of following the curve; this tendency, however, is overcome so far as the truck is concerned by the wheel flanges acting against the outer rail, thus keeping the truck in bounds. The body of the tender, however, being but loosely supported on the center bearings is free to move to the extent of the side bearing clearance and the compressiveness of the springs; the centrifugal force therefore produces the effect of a heavy blow delivered to the bottom side bearing by the kinetic energy of the tender body. The striking force of the blow so delivered is hard to calculate to a nicety, but is above the weight originally carried by the center bearing, and can be expressed as follows:

$$F = \frac{WV^2}{2gR} \text{ where}$$

W = Weight of striking body in pounds.
V = Velocity of striking body in feet per second.
g = The constant 36.16 = acceleration due to attraction of gravitation.
R = Amount spring is compressed in feet.
F = Force of blow in pounds.

It will be seen by the above that the force of the blow is in ratio to the side bearing clearance, every increase in clearance increasing the blow proportionally.

Let us now trace the effects of the blow as delivered. It is first received by the truck side bearing, and thence conveyed to the truck bolster; from there it passes to the spring where the violence of the shock is converted from a direct blow to a push, the moment remaining the same; it now passes to the spring plank, thence to the arch bars, to the journal boxes, to the journal and then back through the wheel to the rail. It will thus be seen that we simply convert the axle into a lever, the force being applied to one end, or journal, the wheel at the same end acting as a fulcrum, while the other end of the axle, together with the wheel and truck side, represent the weight to be raised.

With the exception of the centrifugal action on the truck, the moment of all the other movements is governed by the kinetic energy of the body of the tender, and this energy is combined with the centrifugal action on the truck in such a manner as to raise the wheels bodily off the rail on the inner side of the curve, and hold them suspended while this force has been dissipated or until normal conditions have been restored by the tender coming out of the curve. It is at this point that trouble generally begins. In case the kinetic energy of the tender was sufficient to raise the wheels enough to clar the flanges, or if the build or condition of the truck is such as to produce a like effect, the wheel in resuming its natural position, may fall with the flange on top of, instead of inside of, the rail, and the spring action on the loose body of the tender, giving the entire load an impulse in the direction opposite to that imparted by the centrifugal action, will cause the wheel which now has the flange riding on top of the rail, to take an outward course and consequently result in derailment.

This is borne out by a careful study of tender derailments. In nearly all cases of curve derailments it will be found that the truck left the rail on the inside of the curve, or the tangent immediately following the curve, while on straight track derailments where kinetic energy alone obtains, the wheel will drop off outside of the rail opposite the low spot which first caused the rocking.

In order to trace the effects of the rolling or tilting of the tender and its effect on the truck more readily, we call attention to Fig. 2, which illustrates this without the intervention of springs, arch bars, etc.

When the tender enters a curve at speed or strikes a low place in one side of the track on straight line, so as to cause a rocking of the tender, the major portion

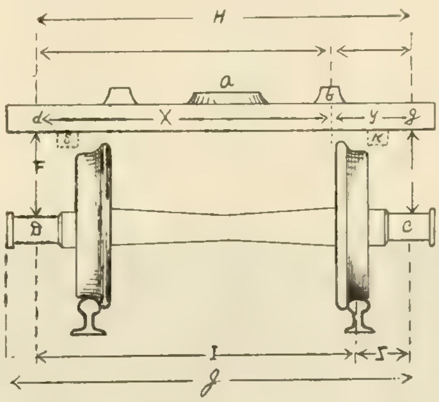


FIG. 2. SKELETON DIAGRAM OF TRUCK.

of the weight is momentarily transferred from the center to the side bearing. In Fig. 2 we assume that the pitch of the tender was toward the right. We therefore have a redistribution of the weight originally all carried by the center bearing (a) so that side bearing (b) will now take a part of it. To that part of the weight transferred to the side bearing, however, we must add the speed or force at which it was transferred, and would therefore be equal at the journal (c), if delivered direct, to, $\frac{WV^2}{2gR}$, but as the other end of the lever rests on the journal (d) a part of this force is necessarily transmitted to that point, the amount being governed by the location of the side bearing in relation to the spring saddles E and K. It is a downward push called C, and exerted at the end of the axle at the point marked C and it would be expressed thus,

$$C = \frac{\frac{WV^2}{2gR} \times (H\text{-}y)}{H}$$

The downward push at point D at the end of the axle, and called D, would be,

$$D = \frac{\frac{WV^2}{2gR} \times (H\text{-}[illegible])}{H}$$

and the force, C, resolved into lifting force, L, would equal at the end of the axle, at the point, D,

$$L = \frac{C \times S}{I}$$

and with the side bearings placed as in Fig. 2 would give 60 per cent. of D a change in the position of the side bearing b, to a point nearer the arch bar, however, would produce a balance between the downward force at D and the lifting force, L, at D as moving the side bearing toward the arch bar decreases the downward force at D and at the same time increases the lifting force, L—so that the two forces would become equal, and therefore leave nothing but its own weight to hold the truck to the rail on that side.

From a casual glance it would appear that the best way to reduce the lifting force, L, at D would be to move the side bearing (b) inward toward the center, thus decreasing the distance, b-d, and increasing the distance, b-g. A glance at Fig. 1, however, will show that this would increase the force, F, by the additional overhang of the tender body, which now enters into the calculation. With the tender on an even keel, the weight as said before is carried on the center bearing (a), Fig. 2. With the shifting of the body as in curving, a tilting action is produced in direct ratio to the distance a-b (Fig. 2), and were this distance decreased to any extent by moving the side bearing (b) inward, the overload due to the shifting of the water in the cistern, together with the kinetic energy of the tender body, would be sufficient to completely overturn it. The difference in the weight carried on either side of the centre bearing when the load (water) shifts is shown by the angle, C, D, E, (Fig. 1), the greater portion of which is shown as beyond the point, a, (Fig. 1) and thereby increasing the force of the blow, F.

It is plain that any reduction of the force, F, would likewise reduce the lifting action, L, and consequently any decrease in the distance, a-b (Fig. 1) would be desirable. This might naturally lead to the conclusion that it would be well to eliminate the distance, a-b, entirely by moving the side bearing (a) to coincide with the point, b, that is, outward, to the extreme end of the bolster, as shown by dotted lines. With the spring seat in its present location, however, we here come in contact with another factor, which, unconsidered, will only lead to disappointment and further derailments. By this proposed change in location of side bearings it will be seen that the side bearing is thrown outside the arch bar and also beyond the spring seat, the spring seat therefore would simply act as the ful-

crum of a lever having one arm equal to f-g and the other equal to f-h (Fig 1), this in case of insufficient bolster clearance (between top of bolster and bottom of arch bar), or in case the bolster clearance were less than the side bearing clearance, would therefore tend to produce a lifting action on the end of the boster at h equal to F multiplied by distance f g, and divided by the distance h f, calling these distances x and y, respectively, we have the equation, lifting force at $h = F \times \frac{x}{y}$ this added to the power, L. would easily raise the wheels clear of the rail.

We see that we must therefore effect a compromise between the different forces, and this is no doubt, exactly what had been done in the seeming anomalous instances before noted. The logical compromise as can be seen is to move the side bearing to a point nearly over the spring saddle center, keeping between the spring saddle center and the truck center, however, and this is why in some instances freedom from derailment was obtained by moving the side bearings in, while in others equally good results were obtained by moving the side bearings out. In both cases the proper relationship between spring and side bearing was established, the springs not occupying the same position relative to arch bars in the different instances noted.

The principles above set forth are well illustrated in the latest type of Pullman sleeper trucks and accounts for their easy riding qualities and comparative freedom from derailment.

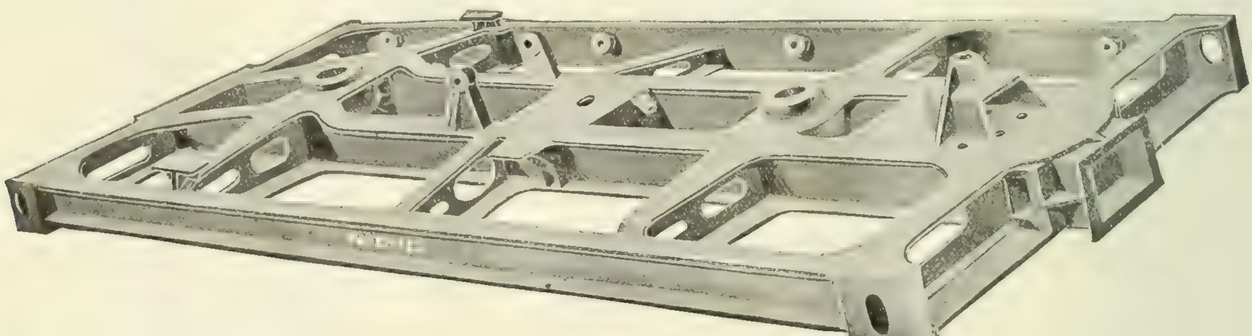
A very handsome illustrated catalogue has come to this office from the Hicks Locomotive and Car Works, of Chicago Heights, Ill. The half-tones show a 54 ft. passenger car for the Atlanta & St. Andrews Bay Railroad, also a 54 ft. combination car for the Western Allegheny, and a 54 ft. passenger, mail and baggage car for the Arkansas, Oklahoma & Western. A copy of the specification of the first car is given and the modification required to cover the other two types is indicated. The folder is tastefully got up and will be useful to any one interested.

A Single Steel Casting

The cast steel industry, although quite new, has grown to be one of the most important factors in the proper designing of railway equipment. Cast steel being both strong and light reduces the cost of maintenance because it permits of simpler and stronger construction, the elimination of joints, or the use of bolts and nuts which may get loose.

STEEL TENDER FRAME FRESH FROM THE SAND.

The Commonwealth Steel Company of St. Louis have always been progressive in working out improvements in railway devices, and the one-piece cast steel tender frame, which is shown in our illustrations, is a good example of what the Commonwealth people have done toward simplifying and strengthening railway equipment. One view shows the tender frame just as it was taken out of the sand, with the risers and pouring gates still attached. On top of the casting can be seen a group of the foundrymen who were responsible for the good work done.



COMMONWEALTH STEEL COMPANY'S ONE-PIECE TENDER FRAME.

The casting of this tender frame with the difficult coring and intricate section was a very difficult foundry problem. It was necessary to have immense flasks which were expensive, and the whole undertaking necessitating special facilities which were arranged for after much experimenting.

The successful manufacture of these cast steel tender frames is an achievement in the open hearth cast steel industry. The cast steel one-piece tender frame will last indefinitely without corroding, rotting or breaking. It is also much stronger and lighter than the ordinary channel steel frame, and will resist severe shocks and collisions. It is altogether quite a notable achievement as a steel casting.

The Jenkins Bros.' pump valves are not only in use in hot and cold water service, continuing to grow in popular favor, in which they have long been prime favorites, but in air compressors, the valves, while extremely hard and durable, yet possess sufficient elasticity to insure absolute tightness under all conditions of pressure. In elevator service where the water is often slightly oily, the valves admirably meet the requirements.

The Tate Flexible Staybolt, having become an article of standard merit, the Flannery Bolt Company, of Pittsburgh, Pa., have established the manufacture of a set of tools for applying the bolts in a most satisfactory manner, and it would be well for boilermakers to get these tools in order to insure a perfect application of the staybolts to the boiler. The preservation of the standard taper of the Tate sleeve is an essential requisite of good work.

A recent press dispatch from Quebec in referring to the fallen bridge at Point Levis, says: Thirty-six actions for damages were issued against the Quebec Bridge Company, and the Phoenix Bridge Company, the plaintiffs being the widows or heirs of some of the victims of the bridge accident in August last. The amounts claimed vary from fifteen hundred dollars to twenty thousand dollars.

Items of Personal Interest

Mr. H. J. Ackworth has been appointed storekeeper for the Erie, at Kent, O., vice Mr. H. E. Lind, transferred.

Mr. B. G. Calloway has been appointed purchasing agent of the Tennessee Central, with offices at Nashville, Tenn.

Mr. W. C. Hayes has been appointed superintendent of locomotive operation on the Erie Railroad, with headquarters at New York, N. Y.

Mr. L. C. Brady has been appointed roundhouse foreman of the Pennsylvania at Phillipson, Pa., succeeding Mr. F. B. McKelvey.

Mr. H. E. Lind has been appointed storekeeper for the Erie, at Susquehanna, Pa., vice Mr. T. H. Keffer, resigned to engage in other business.

The office of the superintendent of motive power of the Mexican National Railroad has been transferred from Laredo, Tex., to San Luis Potosi.

Mr. Sherman Smith has been appointed superintendent of construction of the Grand Trunk at Portage la Prairie, Man., vice Mr. Otis Weeks, resigned.

Mr. I. Jefferies has been appointed acting locomotive foreman on the Grand Trunk Railway at Palmerston, Ont., vice Mr. W. Hamilton, transferred.

Mr. Richard Voges has taken a position with the Ward Equipment Company, New York, as chief inspector of materials in their car heating department.

Mr. H. A. Bonn has been appointed Northwestern passenger agent on the New York, Chicago & St. Louis Railroad Company, with office at Seattle, Wash.

Mr. George Wagstaff, supervisor of boilers of the New York Central & Hudson River, has resigned to go to the Railway Materials Company, of Chicago, Ill.

Mr. E. E. Machovec, formerly general foreman of the Atchison, Topeka & Santa Fe at Newton, Kan., has been appointed division master mechanic at the same place.

Mr. Edward Tucker, formerly roundhouse foreman on the Atchison, Topeka & Santa Fe, has been appointed general foreman at Newton, Kan., on the same road.

Mr. F. K. Edwin has been appointed superintendent of bridges of the New York, New Haven & Hartford at Stamford, Conn., vice Mr. V. V. Wiggin, resigned.

Mr. J. A. Mitchell, locomotive foreman of the Grand Trunk at Stratford, Ont., has been appointed locomotive foreman of the Grand Trunk Pacific, with office at Rivro, Man.

Mr. L. F. Dwyer, formerly foreman of locomotive repairs, has been appointed general foreman, having charge of locomotive and cars, on the Illinois division of the Iowa Central Railroad.

H. L. Mills, formerly in the sales department of the Whiting Foundry Equipment Company, has resigned to accept the presidency of the American Specialty Company, 1440 Monadnock Bldg., Chicago.

Mr. J. H. Munro has been appointed locomotive foreman on the Canadian Pacific Railway, at Muskoka, Ont., the divisional point on the new line between Bolton Junction and Romford Junction.

Mr. H. H. Hale, superintendent of motive power of the Nevada Railroad, has been appointed master mechanic of the Gulf & Ship Island, with headquarters at Gulfport, Miss., vice M. J. Haynen, resigned.

Mr. E. C. Gossett, formerly master mechanic on the Chicago, Rock Island and Pacific at Armourdale, Kan., has been appointed master mechanic on the Iowa Central, vice Mr. T. M. Feeley, resigned.

Mr. G. E. Carson, formerly master carbuilder of the Pittsburgh & Lake Erie, on Sept. 1 took a like position with the New York Central at West Albany, and has been succeeded by Samuel Lynn, at present car foreman.

Mr. T. C. Hudson, formerly master mechanic of the Canadian & Northern Quebec Railroad at Shawinigan Falls, Que., has also been appointed master mechanic on the Quebec & Lake St. John Railway, vice Mr. J. Clark, resigned.

Mr. G. Kydd has been appointed chief clerk to Mr. William Downie, general superintendent of the Atlantic Division of the Canadian Pacific Railway, with headquarters at St. John, N. B., vice Mr. J. G. Shewan, resigned.

Mr. R. V. Hogue, formerly assistant master mechanic on the Denver & Rio Grande Railroad, has been appointed master mechanic on the same road, with headquarters at Grand Junction, Colo., vice Mr. A. H. Powell, tranferred to Alamosa, Colo.

Mr. E. F. McCrea, assistant engineer of maintenance of way of the Pennsylvania Lines west at Cleveland, Ohio, has been appointed assistant engineer of maintenance of way on the same road at Pittsburgh, Pa., vice Mr. S. W. Hodgin, transferred.

Mr. W. Hamilton, heretofore locomotive foreman on the Grand Trunk Railway at Palmerston, Ont., has been appointed locomotive foreman on the same road at Stratford, Ont., vice Mr. J. A. Mitchell, resigned to enter Grand Trunk Pacific Railway service.

Mr. G. W. Taylor, formerly division master mechanic on the Atchison, Topeka & Santa Fe at Newton, Kan., has been appointed superintendent of motive power and machinery of the San Antonio & Arkansas Pass Railway, with headquarters at San Antonio, Tex.

Mr. W. E. Davis, passenger traffic manager; Mr. G. T. Bell, general passenger agent, and Mr. J. E. Quick, general baggage agent, all of the Grand Trunk Railway system, have been appointed to the same offices with the Grand Trunk Pacific, combining the supervision of both lines.

Mr. W. B. Russell, formerly assistant superintendent of apprentices of the New York Central Lines, has resigned to accept the position of director of the new technical school in Boston, known as the "Franklin Union." Mr. Henry Gardner, apprentice instructor at the McKees Shops at Pittsburgh, has been selected to fill the vacancy. His office will be at the Grand Central Station, New York.

Mr. F. D. Crawshaw, B. S. in Electrical Engineering, Worcester Polytechnic Institute, who has served as head of the Manual Training Department of the Central High School, Minneapolis, Minn.; as first assistant, Manual Arts Department, Bradley Polytechnic Institute, and as principal of the Franklin School, Peoria, Ill., has been appointed assistant dean of the College of Engineering of the University of Illinois.

Mr. Shelby S. Roberts, B. S.; C. E. Rose Polytechnic Institute, for the past ten years engaged in railway work, chiefly with the St. Louis, Peoria & Northern Railway; the Louisville & Nashville, and the Illinois Central, has been appointed assistant professor of railway civil engineering in the University of Illinois. Mr. Roberts will give his entire attention to instructional and research work, with reference to railway track construction and maintenance and with reference to railway signalling.

At the convention of the Traveling Engineers' Association held in Detroit last month Mr. J. A. Talty, of the Delaware, Lackawanna and Western, was elected president of the association. Mr. C. F. Richardson, of the Frisco System, was elected first vice-president; Mr. F. C.

Thayer, of the Southern Railway, second vice-president, and Mr. W. C. Hayes, of the Erie Railroad, third vice-president. Mr. W. O. Thompson, of the N. Y. C. lines, East Buffalo, N. Y., was elected secretary, and Mr. C. B. Conger treasurer.

About a couple of weeks ago Mr. D. McNicoll, vice-president and general manager of the Canadian Pacific Railway, completed his forty-second year of active railroad work. On Aug. 20, 1866, Mr. McNicoll, then fourteen years old, did his first day's work as a clerk in the goods department of the North British Railway. He continued in railway service in Great Britain until 1874, when he came to Canada and entered the employ of the Northern Railway. Later he went over to the Toronto, Grey & Bruce, and in 1883 he joined the C. P. R. Here he rose from one step to another till in December, 1903, he became vice-president and general manager. He is also a director of the company.

Mr. A. O. R. Huddell, who recently retired from the position of cashier of the Grand Trunk, before leaving the office for the last time as an official, was called in by the treasurer, Mr. Frank Scott, to a room where the rest of the employees of the department joined them, together with Messrs. William Wainwright, fourth vice-president; N. J. Power, general auditor, and W. H. Ardley, auditor of disbursements. On behalf of the employees of the department, Mr. Scott presented Mr. Huddell with a handsome onyx clock, and briefly expressed the regret felt by the staff that their old comrade was leaving. He assured Mr. Huddell that he carried with him the best wishes of all his fellow employees and expressed the hope that he might live long to enjoy his rest. Brief speeches were made by Mr. Wainwright and other officials.

Announcement

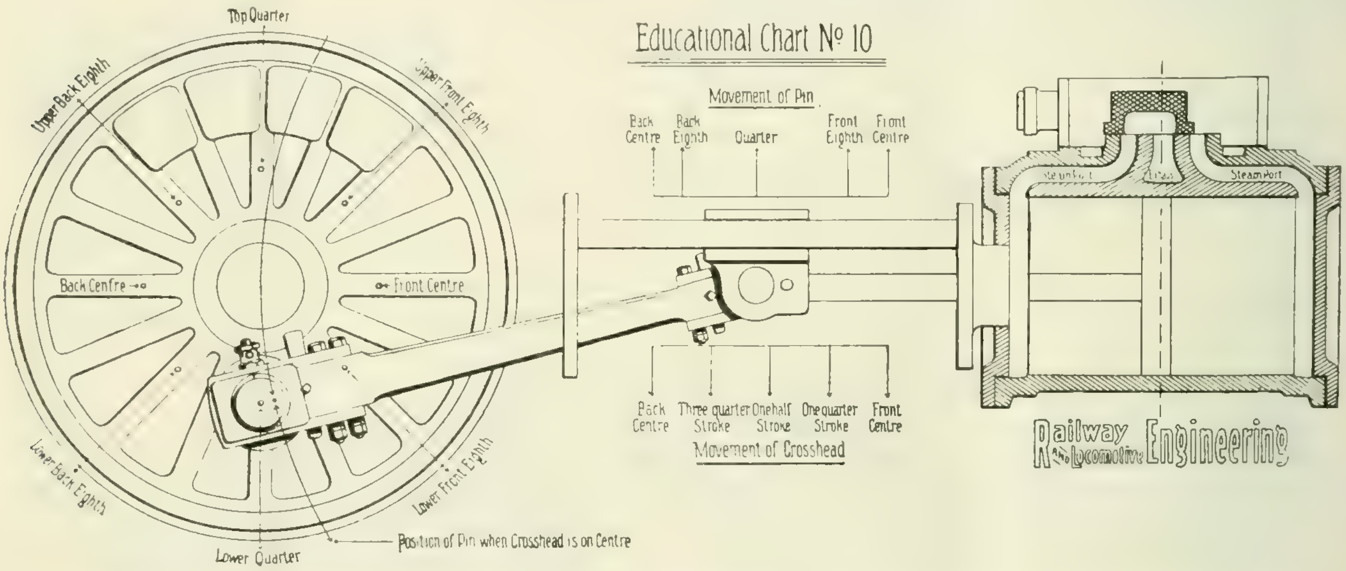
We take pleasure in stating that in addition to our Educational Charts which are given free to subscribers to Railway and Locomotive Engineering, we have now ready a new chart, No. 10, which combines the quality of a working model and educational chart, illustrative of the angularity of the main rod. The movable parts are made of celluloid, mounted on superfine cardboard. The chart also contains a complete series of questions adapted from those in use by traveling engineers.

A careful and studious perusal of these questions, in conjunction with the object lesson, afforded by the movable slide valve, piston, and main rod, cannot fail to familiarize the student with the chief organic features of the locomotive. The changing of a reciprocating motion into a circular motion, and the attendant irregularities caused by the angular advance of the connection between the crosshead and crank are clearly defined, and a thorough knowledge of this interesting problem in engineering is gained that is at once simple and clear. More can be learned in a few leisure hours with this chart than can be gained from years of hard experience in active railway service.

We may add that this chart is not a Twentieth Century product. It was originated by the publishers of *Locomotive Engineering* last century. As our readers well know, Railway and Locomotive Engineering is a larger growth of *Locomotive Engineering,* combining all the features of the original publication with the added requirements of the constantly expanding field covered by the latest mechanical appliances used on railways. Our new chart is a reproduction of one of our earliest charts, with letter-press descriptions.

It is interesting to note that the first issue of this chart involved a production and distribution of nearly 25,000 separate copies among American railway men. With our new and rapidly expanding field opened up by the publication of our European edition, we expect the present issue of the chart will be much larger. Our hundreds of agents and our tens of thousands of subscribers must bear in mind that our regular subscribers on renewing their subscriptions are entitled to a copy of this combination chart and working model, the same as if they were new subscribers.

We need hardly remind them that they can have an alternative choice of any one of our locomotive or car charts. They are distributed free to all subscribers. Our locomotive chart published last year, showing a consolidation locomotive equipped with the Walschaerts valve gear, met with an unprecedented demand and is still being constantly called for. Our aim is to produce something new each year, so that our readers may have some tangible reminder of our interest in their welfare as well as something of real value. Many publishers as well as other prominent business establishments content themselves by issuing a glaring poster from which one may learn what day of the month it is, or what quarter the moon is in. We have no fault to find with the productions. They are useful reminders. But we prefer to go on in the way we began. We know that railway men, especially the younger men, need something more than days and dates and moonshine. They need education in their high calling, and to this end our best efforts will be as unsparingly made in the future as they have been in the past. Chart No. 10 is now ready for distribution to all renewed or new subscribers.



FACSIMILE OF OUR EDUCATIONAL CHART No. 10—THE PISTON AND VALVE ARE CELLULOID AND ARE MOVABLE

American De Glehn for France.

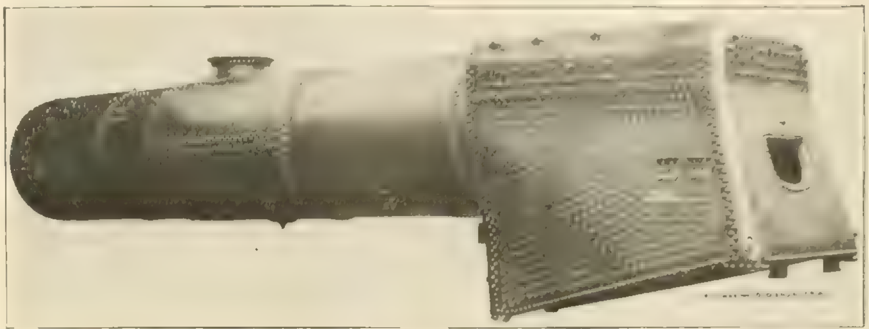
The Schenectady Works of the American Locomotive Company have recently completed an order for 30 Pacific type locomotives for the Paris-Orleans Railway of France. These engines were built strictly in accordance with specifications and drawings furnished by the railway company, which means, that the work was executed to metric system measurements, all the dimensions on the drawings being given according to that system. These engines will be used in fast express service on the division between Limoges and Brive, a distance of 61.27 miles where the grades are long and heavy in both directions.

These locomotives are of the 4-cylinder, balanced compound type, the four cylinders being compounded and arranged on the De Glehn system. A departure from the usual practice in the De Glehn type of locomotive will be noticed, in that the high pressure cylinders are furnished with piston valves, and the steam pipes to the high pressure cylinders are in the smokebox instead of being outside the boiler. The low pressure cylinders are between the frames underneath the smokebox and drive on the cranked axle of the leading driving wheels. The high pressure cylinders are outside the frames, some distance back of the low pressure cylinders, and are connected to the middle pair of driving wheels.

The high pressure cylinders are 15.35 ins. in diameter, the low pressure are 25.19 ins.; the stroke of all is the same, viz.: 25.59 ins. This engine can exert a tractive effort of about 24,940 lbs. with driving wheels 78.83 ins. in diameter and a boiler pressure of about 240 lbs. per sq. in.

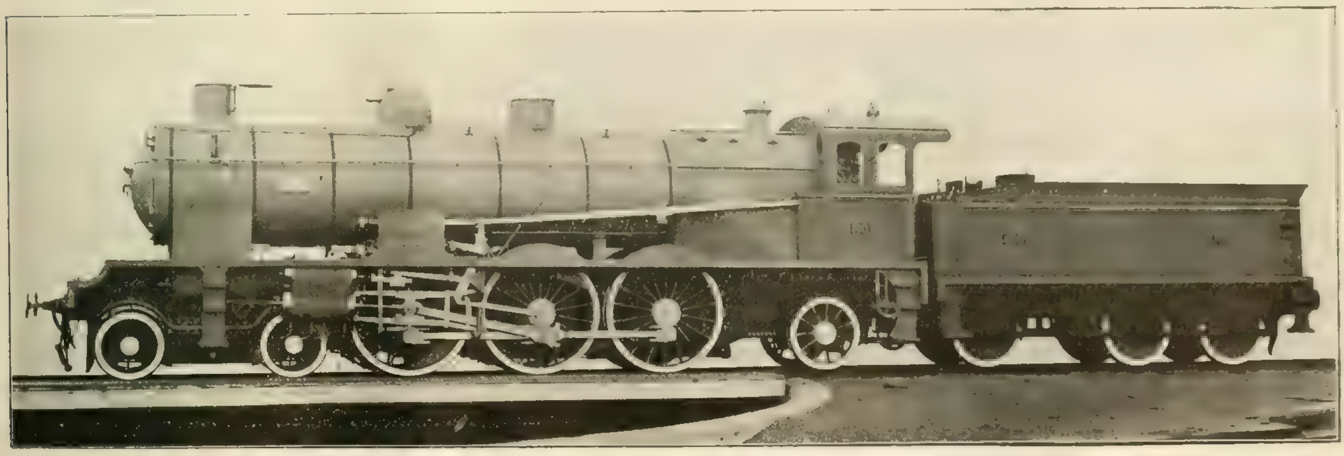
The two low pressure cylinders, together with their steam chests and a receiver, are found within one casting. The low pressure valves, which are of bronze, are of the plain slide type, unbalanced and have inclined seats. In order to provide clearance for the leading truck, all the cylinders are slightly inclined. The two sets of valves are operated by independent valve gears of the Walschaerts type. The gears for the outside cylinders are driven by return cranks forged solid with the crank pins of the middle pair of driving wheels, while the inside gears are driven from eccentrics on the leading axle.

As the centers of the high pressure valve chambers are 4.92 ins. outside of the cylinders, all the parts of the high pressure valve motion are in the same vertical plane; so that the motion of the eccentric crank is transmitted direct to the valve without the use of rocker arms. With the inside valve gears, however, the eccentric being located on the first axle between the inside crank cheeks, the centers of the eccentrics are 13.78 ins. inside of the valve centers. In order to transmit the motion from one plane to the other, therefore, the inside trunnions of the links are extended and provided with downward extending arms, to which the eccentric rods are connected. This arrangement, of course, introduces [illegible] points. [illegible] thus permitting of independently varying the cut-offs in the high and low pressure cylinders.



BOILER OF THE PARIS-ORLEANS DE GLEHN, SHOWING NARROW FRONT AND WIDE BACK OF FIREBOX.

The steam pipes to the high pressure cylinders are seamless drawn steel tubes. Steam from the high pressure cylinder exhausts into intercepting valves, placed in chambers cast on the side of each low pressure cylinder, directly beneath the steam chests. These valves are in the form of hollow cylinders and have suitable openings cut in them, which, according to the position of the valve, allows the high pressure exhaust to pass to the low pressure steam chests and receiver, or to the atmosphere, through a direct exhaust passage cored out in the front of the low pressure cylinder casting. These valves are operated by air pressure, controlled from the cab, the air cylinder being between the frames just ahead of the low pressure cylinders.



DE GLEHN 4-6-2 FOR THE PARIS-ORLEANS RAILWAY OF FRANCE.

Mons. E. Solacroup, Ingenieur en-Chef. American Locomotive Company, Builders.

and the ends of the piston rod being connected to crank arms on the ends of the intercepting valve stems.

Steam direct from the dome is admitted to the low pressure steam chests, and receiver in starting or when working simple, by means of a valve on the back-head of the boiler, which, when opened, allows steam to flow through a small copper pipe, extending from it through the front tube sheet and connecting to the copper pipe, which connects with an opening in the receiver on the right of the exhaust pipe.

The frames are of steel plate made in two sections. The frames are offset at the front end in order to provide room between them for the low pressure cylinders and are very strongly braced together. The low pressure guides and also the low pressure link supports are bolted to the heavy steel box casting between the high pressure cylinders. The outside guides and high pressure link supports are bolted to cast steel guide yokes secured to the frames. All the axles are forged steel, the crank axle being a single forging. The driving boxes are of forged steel.

The three pairs of driving wheels are equalized together, the under-hung spring system being employed. Contrary to American practice in this type of engine, however, the trailing truck is not equalized with the driving wheels. The trailing truck is of the side motion type with inside bearings; lateral motion is provided by allowing sufficient play between the boxes and pedestals on each side, and the load on the truck is utilized to bring the truck back to its central position. The engine truck is the Paris-Orleans standard design of wheel truck, all the weight being transferred to the truck by means of two hemispherical side bearings seated in castings which can slide on the cast steel center frame. The truck is brought back to its central position after leaving a curve by means of two transverse coil springs, one on either side of the center plate.

The boiler is of the straight top type with Belpaire firebox, the inside firebox being of copper. All the stays in the water legs are of manganese bronze, while the crown and the boiler stays are of Falls hollow staybolt iron. One of the most interesting features of the design of the boiler is the shape of the firebox, which extends out over the frames at the back end, and is made narrow at the front end to come between the frames. This was, of course, necessary because of the location of the rear driving wheels which, instead of being ahead of the firebox as in the ordinary American design of Pacific type locomotive, are so placed that they extend back of the front and of the firebox.

The barrel of the boiler has an outside diameter at the front end of about 66⅛ inches. It contains 261 tubes, 2.165 ins. in diameter and 19.54 ft. long.

The total heating surface of the boiler is 3,048 sq. ft., of which the tubes contribute 28,635 sq. ft., and the firebox the remainder. The firebox provides a grate area of 45.7 sq. ft.

The smokebox is provided with a high exhaust pipe fitted with a variable exhaust device. This device consists of a hollow cone fitted in the top of the exhaust nozzle, the largest outside diameter of which is equal to the inside diameter of the tip of the exhaust nozzle. This cone is connected to the horizontal arm of a shaft which extends out of the side of the smokebox and is operated from the cab by means of a screw and a hand wheel. By lowering or raising the cone, the amount of the exhaust opening is increased or diminished. The blower nozzle which is of bronze is a hollow ring surrounding the exhaust nozzle and provided with a number of holes in its upper face. A sprinkling device is also provided in the smokebox for extinguishing hot cinders. The smokestack is of cast iron, and is provided with a hood by means of which the draft may be checked when the engine is standing in a station or drifting.

The tender tank is of the water bottom type and has a water capacity of 20,000 litres or 5,281 gallons. It is provided with three gauge cocks to show the level of the water in the tank. The tender frame consists of two steel plate side frames, placed outside of the wheels and strongly braced together. The tender is carried on six wheels and the weight is transmitted to the journal boxes through semi-elliptic springs over the top of each box; the two rear pairs of wheels being equalized together.

The principal ratios of the design are given below:

Weight on drivers ÷ tractive effort	=	4.89
Total weight ÷ tractive effort......	=	7.81
Total heating surface ÷ grate area	=	66.6
Firebox heating surface ÷ total heating surface, per cent........	=	6.4
Weight on drivers ÷ total heating surface	=	40
Total weight ÷ total heating surface	=	64
Tractive power × diameter drivers, ÷ total heating surface........	=	595
Volume of equivalent, simple cylinders	=	8.48
Total heating surface ÷ volume equivalent, simple cylinders......	=	359
Grate area ÷ volume of equivalent, simple cylinders	=	5.38

Wheel base, driving, 12 ft.; total 34 ft. Wheel base, total, engine and tender, 58 ft. 5 11/64 ins. Weight, in working order, 195,000 lbs.; on drivers, 122,000 lbs. Weight, in working order, engine and tender, 294,800 lbs. Boxes, driving, forged steel; brake, driver, Westinghouse; truck, Westinghouse; brake, tender, Westinghouse; air signal, grate, style, dump arrangement; piston packing; metallic; tender frame, steel; tank, style, water, bottom; wheels, material, cast steel.

Left Driving Box Pound.

At the General Foremen's convention Topic No. 1 was "The pounding of the left main driving box more than the right—The cause and how this pounding can be avoided." There were three papers presented on this subject, one by Mr. C. H. Voges, of the N. Y. C. Lines, one by Mr. E. R. Berry of the C. B. & Q. and another by Mr. W. D. Kidneigh of the U. P. These papers are printed in the July issue of RAILWAY AND LOCOMOTIVE ENGINEERING, pages 296 and 306.

Without exactly quoting the papers we may give the following epitome of the subject, which may assist our readers in following the discussion.

If an ordinary locomotive in which the right hand crank leads the left hand be considered, and assuming that when starting, the right crank is, say, 4 ins. to 6 ins. above the forward center, so that the right valve forward port is not yet open to lead, then if the throttle is opened steam will not enter the right cylinder, but will enter the back end of the left cylinder, and will pull the L crank forward until the LD box strikes the front main pedestal, which will act as a fulcrum and the RD box will move against the RB pedestal. When sufficient pressure is exerted the engine will move and the wheels revolve. When the RF crank nears the center, the R front port opens and steam strikes the piston which transfers the pressure to the R crank pin and then to the RD box. This box, however, is hard against the back pedestal, (as stated above, from the action of the forward pressure on the L piston) and therefore there is no lost motion to be taken up, and no tendency to knock is produced.

Next, assume 90 degs. passed and the L crank to be 4 ins. to 6 ins. above the forward center so that the valve is not opened to lead. Then R crank under the force of the steam is pressing the RD box against the back pedestal, which, acting as a fulcrum, enables the pressure on the R main pin to force the LD box against the *forward L pedestal.* Now when the L valve opens the front port, the pressure on the piston forces the LD box back against the ***back pedestal*** with a sudden blow proportional to the lost motion in the LD box and axle, and thus creates more lost motion. When the exhaust takes place on the R side as the R crank comes up toward the back center it allows the RD box to come gently forward against the forward R pedestal under the influence of the L cylinder pushing the L crank pin back, so that when the R crank reaches the back centre and the R back port opens, the steam pulls the crank

pin forward, but the box is already against the front pedestal so that the lost motion on that side has no effect. On the fourth center the R crank is on top, the L crank at the back end, and the LD box is against the back pedestal, having been *put* there by the L piston and *kept* there by the R crank acting as a lever on the axle, so that when the L valve back port opens, the steam again knocks the LD box, this time against the forward pedestal, with the force gained through the lost motion.

Several opinions were expressed by members, and among those given we may partially quote as follows: Mr. Ogden said: "I think Mr. Voges has the matter pretty well covered. There isn't any reason why there should be any more pounding on the left side than on the right, if the left side has the same attention as the right. With our engines we have a steam pound

OLD GEAR ENGINE AND SOME SCRAP HEAP COMRADES.
Photographed by L. C. Wooley.

that is all over the engine, but we don't have any more on the left side than we do on the right, but if we do have it on either side it is due to the wedges not being put up by the engineer, or an unequal distribution of steam. I do not see anything in it except for the engineer to keep the wedges up on the left side. We have a great many broken frames, and with very few exceptions it is always on account of the binder being loose and the wedge not set up, and about nine out of ten break on the left side. Sometimes we have a number that break on the cylinder side. We know what the trouble is when we find the binder pulled loose. We found two or three broken by men throwing their engines into simple on a heavy pull and doing it while the engines were working the hardest. I believe it is up to the engineer, if anybody."

Mr. Gorman said: "An engineer should take care of his shoes and wedges. It [illegible] engine go down and keeps up the right side. I do not think [illegible] I cannot see any reason why there should be a pound on one side greater than on the other."

Mr. Voges remarked: "This matter has been taken up by the Master Mechanics for years. [illegible] paper, the [illegible] careful man [illegible] on the left side and [illegible] Mr. [illegible] driving box on the left side and [illegible] it to a certain extent for a certain length of time."

Mr. Bryan said: "[illegible] I have been up against [illegible] It is a fight we had on the [illegible] western twelve years and I suppose they are still having it. As far as I have been able to learn from experience and a study of the matter I think the idea that Mr. Voges has expressed [illegible] about the only explanation that I have arrived at. In the last two years I have run against another disease on the left side which I think comes from the same thing, but I have been unable to determine. On the double shaft type of the Soo Line engines, the left side, that is the high pressure side, the engines pound their left main tire from 18 to 24 ins. ahead of the pin, and they are having the same difficulty as with the left main driving box. We have had left main tires pound out in six weeks. For a long time we thought it was soft spots in the tires and happened to catch in the left main wheel, but as soon as the spot commenced to show up we would take it out and put it on the front wheel. And while I think it comes from the same cause we cannot lay it entirely to slack. There must be a back pressure of some kind and it may develop in a cross compound engine oftener than in a simple."

Mr. Kelly of the N. W. remarked: "As I see it, the pound in the left main driving box is due to the right lead and that subject is covered very well in Mr. Voges' paper. We had trouble with the left frame breaking more than the right, and I understand that the broken frame was transferred to the right side, showing that the lead has all to do with the pound. It seems to me it is conclusive that whichever side has the lead, the other will have the pound."

Mr. Maultbie said I have never noticed anything of the kind. It seems to me that if the same care were taken of the left as with the right that such a pounding more on the left side could not happen. I have heard of that being the case, but I have been unable to find a reason for it. I think if the box is properly bored out and properly fitted and the same care taken, there should not be any more pound on one side than on the other.

Speaking about boring out the boxes Mr. Voges said: "In regard to the shoes and wedges being set properly engine 6416 received first class repairs. A mileage was made of about 25,000. We renewed all the bolts and the engine was fitted up A1. The engineer is a mechanic himself and he takes good care of his engine. Why did he set up the left wedge lower than the right one? We paid particular attention to shoes and wedges. On some roads they bore the back 3/32 larger than the journal and the main box they bore 1/32 larger. We bore all boxes and fit them close to the journal."

Mr. Hanse said: "There is something in the journal being out of round. An engine was brought in with a pound, taken to the pit and I gave that engine two new boxes. The journal was out of round about 1/32 in. I had its brasses bored and box fitted, and it was a perfect job, and to-day that engine is pounding badly on the left side. The right side is just as nice as ever. In regard to setting up wedges, as a rule the Seaboard Air Line have regular engineers on through freight and passenger and engineers set up their wedges. With the grease boxes you cannot set up a wedge until after you run the engine 15 or 20 miles. All grease cellars heat the boxes. They have to create friction before they get any lubrication. When they get warm they will expand. If you set up a wedge on a grease cellar box when the engine is cold you will get a stuck wedge. The best time is when it comes in at the end of a trip. I have a Richmond engine that went through the shop on the 5th of January. It was given a thorough overhauling. It has as good an engineer as there is on the road, and to-day it has a terrible pound in the left side. What causes that pounding I am unable to say. I do not depend entirely on the engineer's report. I can get on one of my engines with a machinist and we set the wedge up just as tight as we can get it, and we try it. I have actually seen them jump, it seemed to me a quarter of an inch, but of course it wasn't that much. It is in the brass; it isn't in the shoe or wedge."

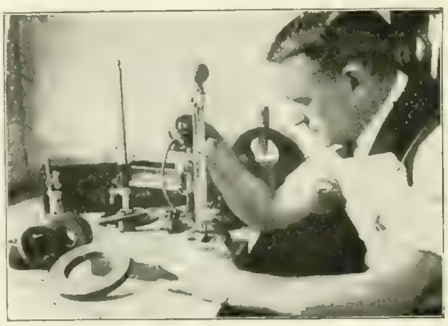
This forms a brief synopsis of the remarks of most of the speakers and the discussion shows that the subject is worthy of careful attention. Any of our readers, engineers and others who can throw any light on how this left side pound can be mitigated, should send in the result of their experience; we will be glad to publish what they say.

Instrument for Testing Hardness.

By J. F. Springer.

There have recently been developed several methods for determining the *amount* of hardness in various substances. The instrument described is one of the best of these, and is called the *scleroscope,* from the Greek words meaning *hard* and *see.* This device is intended to measure how much harder one thing is than another. Thus it determines hardened tool-steel to be about three times as hard as the same material annealed. Further, it gets down to close quarters and distinguishes the slight difference in hardness that sometimes exists between a brass box and the steel journal within it.

By referring to Fig. 1, a glass tube is seen to be a prominent feature of the device. This tube is open at the lower end. There is a little hammer much the same shape as a cartridge, but having a sharper point. When operating the instrument



TESTING THE HARDNESS OF METAL.

this hammer is dropped freely through the length of the tube, about 10 inches, with the point down. When this tiny hammer, weighing about one-twelfth of an ounce, strikes the specimen to be tested, it makes a permanent indentation. The blow struck is a very severe one, notwithstanding the light weight, on account of the sharpness of its point. In fact, the impact is calculated to amount to 75,000 lbs. to the

square inch. This is beyond the elastic limit of most substances. Consequently, a permanent deformation is effected. In doing this work energy is expended. The amount of energy is measured by the resistance to actual displacement of metal. But whatever this resistance is, the reaction against it is equal to it. This is measured by the rebound of the hammer. Assuming, as it seems reasonable to do, that the resistance at the moment of permanent deformation is due to hardness, we have in the rebound a means of measuring the amount of this property.

A scale is placed behind the glass and the rebound measured, thus readily gives a quantitative value for hardness. The scale actually used is graduated from 0 to 140, each graduation being about 1-14 of an inch. If a piece of babbit metal causes a rebound of 7 graduations, while a gold coin shows one of 14, we say that the gold is twice as hard as the babbit metal, inasmuch as the one rebound indicates twice the resistance to deformation of that disclosed by the other.

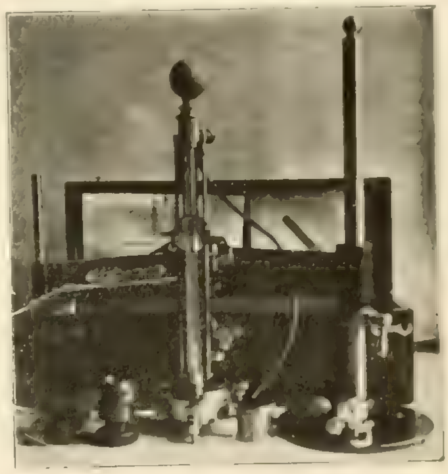
The glass tube is held in position by a suitable framework, the rod seen to the left being a part of the support. The rod to the right of the tube swings freely from its attachment at its upper end. It is, in fact, a plumb-bob, and accomplishes the service of indicating if the tube is in a vertical position. The bulb at the top is for the purpose of sucking up the little hammer after it has performed its duty. The hammer, upon being thus drawn up the tube, is held in position by a suitable catch. When it is desired to make a test the hook, seen near the top and to the left of the tube, is held down and the lower rubber bulb is compressed. The hammer is then free to fall.

There is a magnifying glass, which may be adjusted to any position in front of the tube. As a rule, in testing, it will be known approximately where the rebound will be completed. The magnifying glass is adjusted to cover this region of the tube. The reading of the rebound against the scale may then be easily performed.

What has now been described constitutes the essentials of the instrument. It may be used without other attachments. With the device in this skeleton form one may climb up on a shaft and test journal and box in position. This adaptability to the duty of measuring hardness without disturbing the parts is of importance.

The abrasion of metal is very minute and may be disregarded, unless one thinks that the sharp point will set up an initial point of fracture. In such case a blunt hammer may be used for the lower degrees of hardness. The rebound is less, however, and one might need to make a couple of comparative tests beforehand in order to be able to translate the reading with the blunt hammer into the proper number corresponding to the sharp one. Indeed, this blunt hammer is recommended for use with the softer metals, as it enables finer distinctions to be made.

The scleroscope may be used in connection with a rigid upright, or it may be attached to a swinging bracket. It is of importance that the specimen present a clean horizontal surface. If it is regular in shape and small, it may sometimes be secured in a suitable clamp, and it is necessary that its support be rigid. If the specimen is small and irregular under-



THE SCLEROSCOPE.

neath the device may be employed of embedding it in a preparation of tar and asphaltum. This substance has the property of being very rigid for instantaneous blows, but of yielding to slow pressures. Both of these qualities are utilized. The irregularities of the under portion of the specimen are slowly pressed into the tar-asphaltum. The blow struck by the scleroscope hammer is practically instantaneous. Consequently, the specimen is well supported despite the irregularities, and is rigidly supported for the quick blow.

It is interesting to note the different degrees of hardness possessed by various metals, and even by the same metals under different conditions. Lead in the ordinary condition is so soft as to effect a rebound of but 2 gradations. When its particles are compressed by hammering or rolling it may disclose a hardness of 3. Brass varies all the way from 12 to 30, depending upon its composition and upon whether it is cast or compressed. Wrought iron may show a hardness of but 18 gradations, but upon being hammered may rise to 30. This is about the same degree of hardness as that shown by tool-steel when properly annealed. Unannealed steels show their condition by means of the scleroscope. Hardened tool-steel shows a hardness number which may range from 90 to as high as 110. This is somewhat better than high-speed steels, which vary from about 80 to 105.

The scleroscope is especially valuable in enabling the machinist to determine the hardness of his high-speed tool when it is at the temperature of actual service. This

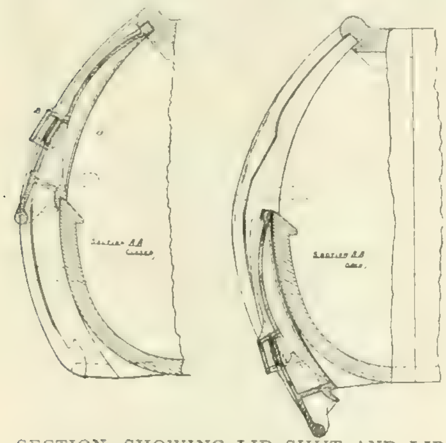
is of very great importance, as what one wishes to know about a high-speed tool-steel is, not so much how hard is it when cold, but how hard is it when as hot as it will be when making a heavy cut in a railway repair shop or when cutting work having a high peripheral speed.

A very important law has been formulated, which should be of great practical interest to machine people. It is maintained that the cutting tool must be from three to four times as hard as the work to be cut if its length of service and effectiveness are to be of commercial value. Thus, if the tool-steel to be machined be so poorly annealed as to be, say, 35 hard, then it is barely a commercial proposition to attempt to cut it. For the best steel discloses but a hardness of 105 or 110. But annealed to 31, it can readily be cut by steel of 100 to 105.

New Era Journal Box.

There is a new axle box on the market for railroad use which is called the New Era, but as a matter of fact it could be called the new departure box because it has some excellent features which rcommend it to any practical railroad man who uses it.

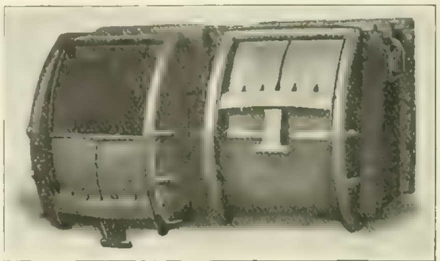
The box is M. C. B. standard and made of any desired material and is a good, clean, strong casting. The point that this box makes its appeal on, is the lid. When open the lid drops down out of the way and leaves a completely unobstructed opening for the removal of brasses and wedges for oiling and inspection. When we say that the lid drops down out of the way we mean it, because the whole front of the box has a slight



SECTION, SHOWING LID SHUT AND LID OPEN.

curve which the lid fits, and when down it is really out of the way and lies close against the bottom face of the box, and is protected from being struck by any passing object. The lid slides in two grooves cast in the edges of the box so that the sides are dust-proof. When the lid is in place closing the box, its upper edge fits into a recess in the top of the box so that it is dust-proof and at the same time the lower edge of the lid fits on the sharp lower edge of the box opening and rests there free from jar or vibration, thus forming a good dust-proof joint. When the lid is down so that the box is open, the lid rests on a pair of lugs cast at the lower end of the grooves in which the lid slides and the lid rests on these in the position which we described as being out of the way.

This dust-proofing is accomplished without any machine work having been resorted to in order to make the joints tight. The box and the lid are simply good, clean, accurately made castings and



BOX WITH LID OPEN AND SHUT.

suit one another as a glove suits the hand. Across the centre of the lid a spring is inserted. It passes through a little boss in the middle of the lid. The spring is flat steel capable of being sufficiently put in place by hand. The spring is just as long as the box is wide, and when in place it cannot come out, and being encased in the front of the cover it is not liable to be injured. When the lid is in its closed and locked position it is like a trap door dropped home with all its edges tight and a full bearing on each edge. The spring simply serves to hold it in this locked position. The work of the spring is therefore so slight that there is practically no wear to it, and it can perform its light but important duty indefinitely.

The opening and closing of the lid is positive, and it can be very quickly done, thus enabling inspection and oiling to be most rapidly accomplished. The lid never remains in a partly opened or closed position. It is either full open or shut, and that is all there is about it. The opening of the lid is easy and there is no possibility of its working hard, so that there is no incentive for an oiler to pass by this box because of trouble in getting at the interior. The lid is not only dust-proof, it is water-proof.

As to the manufacturing of the box and lid, and the fitting of the lid to the box, the working of the lid depends on making of the grooves properly, and as the grooves depend on the core only there is no trouble in making the box with proper grooves and no trouble in the fitting or working of the lid. The opening and the ways are not quite parallel, thus making the lid fit tight on the sides when closed and giving it a little play on the sides when open. All that is

needed is a smooth casting of the lid and a clean core for the grooves in the box. The lid and spring are quite light and there is no reason why the box and lid should be made any heavier than any other box, and not having any machine

NEW ERA BOX, OPEN.

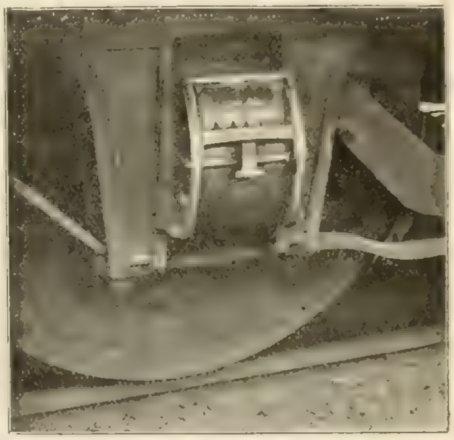
work or bolts, nuts, cotters, etc., the box can be made cheaply.

To open the lid, pull it out at the bottom by taking hold of the lug, and when pulled out as far as it will go, a downward movement causes it to pass below the cam and it will readily fall to its full open position, and is stopped there by the spring coming against the offset or bottom lugs in the groove. To close the lid, lift the lid up till the spring strikes the cam then force it up till the lid comes against the top of the opening when the bottom of the lid is forced past the offset to its closed position by the spring and holds; it is there held and locked. To take the lid off, put it in the full open position and compress the spring so that it will pass the stops in the groove, and it readily comes out. Then to put the lid in, as the stop has a cam face on the lower side, the lid is simply pushed up so as to pass the spring over the stops and the lid is then in position for use. It goes in or comes out from the bottom, but it does not shake out; it requires to be definitely taken out, when required.

The New Era Axle box is worth looking at, for it is a simple and effective device. Mr. Sinclair J. Johnson, of 10 Wall street, New York, who is the patentee of the box, will be happy to send a descriptive circular to anyone who writes to him for one, or he is prepared to supply the boxes on short notice. The box in use has proved satisfactory.

A pamphlet recently issued by the American Locomotive Company is a reprint of the paper on the Walschaerts Valve Gear read by Mr. C. O. Rogers, Travelling Engineer of the company, before the Eighth Biennial Convention of the Brotherhood of Locomotive Engineers, at Columbus, Ohio, May, 1908. The purpose of the paper was to explain in a simple and plain manner the principle, action, and construction of the Walschaerts Valve Gear, and the difference between it and the Stephenson link motion; and the pamphlet will, [illegible], be of especial interest to locomotive engineers and firemen. One section that contains suggestions and recommendations regarding [illegible] in the case of break-downs on the road, will in particular be of [illegible] to those running engines equipped with this type of valve motion. A number of illustrations of engines, [illegible] and blocked as recommended, are given to assist in a clear understanding of the text. A copy of the pamphlet will be mailed upon request. The pamphlet is standard with the other publications of the company and is No. [illegible]. It is an interesting and useful treatise which can be had for the asking. The address of the American Locomotive Company is 30 Church Street, New York.

Red lenses used in railway signals are often more or less defective from what may be called the spectroscopic point of view. If the glass gives a good red color it probably does so at the expense of its



BOX CLOSED AND LOCKED.

light-transmitting qualities and vice versa. When the color becomes thin the light carries farther but it is tinged yellow. Even solid ruby glass is not free from this possible defect.

In speaking of these matters the *Signal Engineer* says that red lenses should be tested for the presence of yellow, by the sodium flame, which is intensely yellow, and all lenses should be tested on a photometer, also tested for focus and for minimum dark crescents due to the corrugations of the lens.

Good practice in dealing with lenses is for a railroad to determine the maximum range to be allowed, and the hue of a given color. The manufacturer might then test each lens before it goes to the customer, and each lens should be sent the customer with its photometric value marked on it.

New Caledonian Brake Vans.

Our illustration shows the latest Caledonian Railway innovation, namely, a Corridor Bogie Passenger Brake Van, which, in addition to having a gangway at either end, is 2 ft. longer and 6 ins. wider than any previous type. The length of body is 50 ft., height from floor to ceiling 7 ft. 9½ ins. and width 9 ft. The underframe is of composite construction. The side-soles, headstocks, bogie and centre cross-bearers are of channel section steel 9 x 3½ x 3½ x ½ ins., the intermediate cross-bearers being of angle section 3 x 3 x ½ ins. The cross-bearer to which the dynamo is attached has its lower member of 4½ x 2½ x ½ ins. section. The longitudinals and diagonals at headstock are of oak. The floor for a distance of 20 ft. from each end slopes toward the longitudinal centre, along which is a 2 x 1 in. gutter, communicating with three drain pipes.

CORRIDOR PASSENGER BRAKE VAN, CALEDONIAN RAILWAY.

There are four double luggage doors on either side, and a centre Guard's door opening inwards. In the Guard's enclosure, which is partitioned with glazed screen, are two side seats, under which are placed storage heaters and a locker for valuables. The electric light for night illumination is supplied by an axle-driven dynamo and accumulators, there being six double roof lights, two Guard's lights and two side lights. The internal fittings include electric bells, cycle racks. The four-wheeled bogie frames are of pressed steel. The wheels are 3 ft. 9 ins. diameter and have steel centres. The journals are 9⅛ x 4 ins. The axle-box bushes are of gun metal, lined with white metal. Wheel base of bogies 8 ft., and of the Van 42 ft. 6 ins. The tare of the Van 24½ tons.

These Vans, of which six are now in traffic, have been built at the company's workshops, St. Rollox, to the designs of Mr. J. F. McIntosh, Locomotive, Carriage and Wagon Superintendent of the Caledonian Railway.

To reduce the cost of freight car repairs and increase the usefulness of each car, the Pennsylvania Railroad has recently impressed upon brakemen, repairmen and inspectors the necessity for careful coupling of cars in yards, the care of air brakes, and the making of minor repairs to cars. A general notice has been issued, going into the matter very fully. Bumping cars together with a severe impact is one of the things specifically referred to, the speed of cars is not to exceed two miles an hour. Brakes must be handled carefully so that cars going over humps in yards will not move fast enough to exceed the two-miles-an-hour order when coupling. Records are to be kept of cars damaged in shifting, and these are to be carefully followed up by general foremen and master mechanics. Repairs to air brakes and the replacing and tightening of bolts must be done in the yard by repairmen, so as to avoid the greater damage that results from neglect. Each repairman is to be required to carry a kit of tools for making all manner of minor repairs.

An attractive little booklet of envelope size entitled "Dixon's Ticonderoga Flake Graphite" has been received at this office from the Joseph Dixon Crucible Company of Jersey City, N. J. It is printed in two colors, black and red, and the color scheme is carried out on the cover by using a black paper and red ink for printing the cover design which shows a title in the form of a seal. The subject matter is so arranged that each page deals with some particular phase of the graphite subject. At the bottom of the page is given some reliable testimony bearing, whenever possible, on the particular point treated of on that page. Anyone who is interested in machinery of any sort will probably find in this booklet some matter to interest them. There are only a few pages, but some interesting and valuable information is given. Any of our readers desiring a copy of this booklet may secure it by writing direct to the Dixon Company for it.

Machine Shop Reminiscences.

VI. Billy's Boarding House.

The young railroad men of the twentieth century, living in hotels and supplied with all the luxuries of the season, know little of the simple life of the last generation. Around the corner from the shops where Billy worked there was a boarding house kept by an ill-assorted couple. The man seemed to have been born with the incurable leprosy of laziness heavy upon him. The woman was thin from excessive toil. The boarders were huddled together like emigrants in a transatlantic steam ship. In winter the place was like an ice house. In summer the heat was something fierce. The supply of provisions was a variable quantity, like the ebb and flow of the tide in the Bay of Fundy. After pay day there was lots of provender, such as it was. Towards the end of the fiscal month the supply tapered off until it threatened to become a minus quantity. At the best of times the meat was tough as India rubber. The butter was strong enough to have walked from Orange County itself. The potatoes looked as if they had seen better days, and as for the coffee is was so muddy that the sugar almost refused to sink in it. The smell of decaying vegetable matter that lingered around the establishment took away the larger portion of whatever appetite the boarders had. Of course they had Clark's parlors to fall back upon as a kind of preserve, so that there was always something between them and starvation.

There were three classes of boarders, like railway passengers in the old country. Billy was in the first class and had a hall room to himself. There was an asthmatic night watchman who occupied Billy's room all day but Billy had no objection as long as he had the place to himself at night. A Professor who fiddled all night and slept and smoked all day exchanged berths with Jack Macfarlane, who was also in the first class. In other rooms there was a moving multitude of noisy men who talked of packing, piston rings, inside lap, outside clearance, loose wedges, low water, leaky flues, cool air, hot boxes and other round house topics. In the garret there were emigrants that came and went with bundles on their backs and whiskers on their jaws that waved like lace curtains out of the car windows as they were winged westward.

It was not to be wondered at, although the boarding master and mistress dwelling in this railroad atmosphere, caught something of its spirit. The trains that came thundering past their door came to be a part of the routine of their daily life. At five-forty in the morning the Western Express shook them out of their slumbers and the battering of the beef-steak commenced its prophetic tattoo in the back kitchen. At six-thirty the Local came tearing along, followed by a rush of boarders down-stairs to the dining room, where they seemed to engage in a competition in choking themselves. Then came a string of trains that followed each other at fixed intervals till late in the afternoon. Each train seemed to bring an avalanche of new duties to the busy boarding mistress. Unaccomplished domestic tasks came to mind with each new train. The railroad was like an eight-day clock to her. It had the advantage that it saved her the trouble of winding. She had enough to do without that, and so an old cuckoo clock with a wooden leg stood still on the mantelpiece and forgot to repeat the hours.

One August afternoon when there was a sulphurous stillness in the air, something happened on the railroad. The coming of the trains ceased. The old "49" was having ill luck again. A piston rod snapped at the crosshead and smashed the cylinder head to atoms. The main rod took the opportunity to break away from the wrist pin and began tearing the earth up like a steam shovel on contract work. Something struck the running board and it went up in the air like a sky rocket. The rails spread away from each other and the locomotive headed for the other track but was cleverly stopped by the engineer before it got half way. The road was blocked for two hours.

OLD TIME PRINT OF THE RAILROAD TRAIN.

During the period of tumult an air of hollow serenity fell upon Billy's boarding house. The afternoon crept on silent and sure as old age. The boarding master was lounging as usual in Clark's parlors.

The mistress sat with her weary hands folded and waited the coming of the train that was to her a notice that it was time to peel the potatoes. The multitudinous murmurs of the city came to her like a lullaby and softly the weary eyelids closed and visions of green fields and shining waters came to her. She was dreaming dreams of the Fatherland, blessed dreams that rub out the unkindly present with the hallowed and transfigured memories of happier things.

Suddenly the whistle of the "Dolly Varden" was heard rending the startled air. Then the Buffalo Special came thundering on like a black eagle chasing a wood pigeon. Then the "Nelly Bly" came screaming along, followed by a loose-jointed coal train. By the time a rattling string of "empties" had passed, the shop whistle joined in the crowding clamor and the hungry boarders swarmed around the bewildered boarding mistress. She tried in low Dutch and poor English to explain the cause of the delay. She appealed to Billy and he mounted the dining room stairs and began haranguing the maddened multitude. A heavy laden delegation of European raw material arrived upon the scene and gaped in open mouthed wonderment at the threatening tumult. The boarding master, who had flashes of sense at times, performed a skillful manoeuvre by deploying the new contingent, including baggage, to a temporary retreat in Clark's parlors.

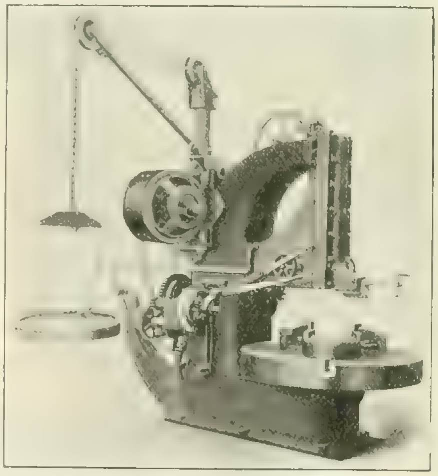
Billy went on with his speech. When Billy had once fairly begun speaking there was no stopping him. He roused the boarders to action as Demosthenes roused the Athenians. One unruly boarder, a red-headed Scot, refused to be persuaded. With his trunk on his back he brushed Billy rudely aside. He had passed the disputatious period and he was moving. Jack Macfarlane and Shaw the haddock man and Billy sallied forth with baskets and brought them back filled to overflowing. Pumpernickel shaped like case shot, and cabbages which, when a kettleful of boiling water was poured upon them became apparently palatable, were in plenty. Pyramids of pretzels and pig's feet from Clark's parlors were added to a variety of odds and ends from a neighboring grocery furnished by a promising lad who slept under the counter and who was growing fat by eating what nobody else would buy.

Just as they were about to sit down to their belated supper an order came from the shops for the day gang to report for duty at once. There was no rest till the "49" was out again. Billy and his companions had a hard night of it, and when the "five-forty" came along next morning the weary workers tottered feebly to Clark's parlors. The "49" was ready for the road again, and in the still morning air could be heard the repercussions of the wooden hammer that was beating the beef-steak into some semblance of edibility in the back kitchen of Billy's boarding house.

Motor Driven Car Wheel Borer.

Our illustration shows a late type of motor driven car wheel boring mill with improved automatic chuck, friction feed discs and crane attachment. It is a 54-in. machine and its heavy construction and powerful gearing renders it capable of taking the heaviest cuts required for this class of work. The automatic chuck is self-closing, self-opening and self-centering. It has three adjustable abutments, each provided with an equalizing steel jaw with two bearing points. The work is thus held and centered by six points on the circumference, insuring accuracy in centering.

The first movement of the driving shaft causes the jaws to close in upon the work, after which the motion is transmitted to the table to produce rotation. When the work is completed, the chuck is released by disengaging the driving clutch and retarding the driving shaft by means of the friction brake provided for the purpose. The inertia of the table and work thus imparts the necessary force to open the jaws. The work is secured in its correct position in the machine and released with no loss of time and without labor. Since the power of the clutch grip increases with the resistance of the cut, it is not necessary to stop the table to tighten the chuck.



ELECTRICALLY DRIVEN BORING MILL.

The boring mill is especially arranged for electric drive, and the motor is mounted on the vertical housing of the frame. The motor is a Westinghouse type "S" for a variation in speed of approximately two to one, and therefore eliminates the cone pulley required by line shaft drive. This increases the machine capacity because the variable speed motor gives the desired range of speed in much smaller steps, permitting

the mill to be run at all times at its maximum. The mill is manufactured by William Sellers & Company, Inc., Philadelphia, Pa.

A large number of appointments has recently been made to the staff of the College of Engineering in the University of Illinois, of which college Prof. W. F. M. Goss is dean. The organic growth of the School of Railway Engineering and Administration, which was established two years ago by the University of Illinois, has been remarkable. This school stands midway between the College of Engineering and the Department of Economics. Its director is Dr. Goss. Its organization within the College of Engineering at present consists of an associate professor of railway engineering, in general charge, and especially concerned with the problems of railway equipment; an assistant professor of civil engineering, especially concerned with problems of the track; an instructor in railway mechanical engineering, especially concerned with locomotive performance and train resistance, and an associate in railway engineering, particularly concerned with the specialized problems of electrical traction. Its organization within the Department of Economics consists of a professor of railway administration and an instructor in railway accounting.

The Niles-Bement-Pond Company of New York have placed before the public a very artistically printed catalogue of their boring mills. The half-tones are excellent and the descriptive letterpress is clear and to the point. The results of fifty years' experience in the building of boring mills are shown in this catalogue. Not only are these mills of superior general design, but particular attention has been paid to details, and the builders' long experience has enabled them to incorporate in these mills many minor points which it is impossible to cover in specifications, but which conduce much toward the value of a machine. The use of speed box drive, rapid power traverse of heads and positive gear feed has somewhat increased the complexity of the machines, but even a cursory examination of the illustrations on the pages of the catalogue will show that simplicity of design has been always kept in view. A copy of the catalogue will be sent to anyone who will send his name and address to the company, 111 Broadway, New York.

The Westinghouse Air Brake Company have issued Instruction Pamphlet No. T 5037 which covers their No. 12 EL locomotive brake equipment. This equipment is an adaptation of the ET steam locomotive brake equipment to meet the requirements of construction and operation of electric locomotives. The book is standard with other publications issued by the company and contains a very full and complete description of the apparatus. The pamphlet is sent free on application addressed to the Westinghouse company at New York, and any one who is connected with or interested in the operation of electric locomotives should secure a copy.

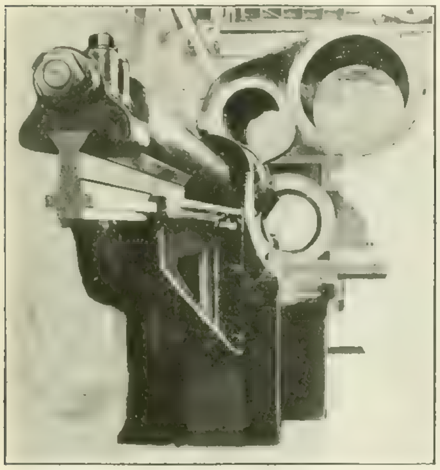
"LONE TREE" FILL. UNION PACIFIC. 400 FT. WIDE AT BOTTOM, 8 FT. WIDE AT TOP.

A heat-proof putty is formed by mixing a handful of burnt lime with 4.25 oz. of linseed oil, boiling down to the usual consistency of putty, and allowing the plastic mass to spread out in a thin layer to dry in a place where it is not reached by the sun's rays. When required for use it is made plastic by holding over the funnel of a lamp; on cooling, it regains its previous hardness.—*Blacksmith and Wheelwright.*

Boring Multiple Cylinders.

At the Topeka shops of the Atchison, Topeka & Santa Fe there has been built a cylinder boring mill for all classes of compound engines. This machine is so arranged that it can bore cylinders on engines which have one cylinder or chamber at an angle to the others, and the work can be done at one clamping by the mere raising or lowering of the table. This table has an elevating movement of 37 ins., also has a cross travel of 35 ins. The table which has the cross-travel movement has also a swiveling motion by which a range of 15 degs. incline may be had.

This new boring mill is direct motor driven. The table is raised or lowered by power connection with the main motor through beveled gears and clutches,



H. P. CYLINDER PARALLEL WITH BORING BAR, VALVE CHAMBER AND L. P. CYLINDER OUT OF PARALLEL.

handled from the operator's side of the machine. The boring bar is 7 ins. in diameter and is made from open hearth steel, and is fed through the cylinder by means of a spur gear and rack which makes it rigid in operation and gives a very smooth bore. One of the facing heads on the machine is made so that it will move along on the bar and is driven by means of 1 in. key and set screw.

The facing heads are fed by means of a star feed attachment. The screws that elevate the table are made from soft steel and are 5½ ins. in diameter and are ¾ in. pitch; the screws, set at right angles to the boring bar, make everything rigid. The total weight of the machine is about 15 tons, and it takes up a floor space of 223 square feet, having an extreme length of 21 ft. and overall range in width of 14 feet.

This machine is capable of boring a three-chamber compound cylinder in 15 hours. A simple cylinder can be bored in three hours.

On the old style boring mill it has taken from 26 to 28 hours to bore a three-chamber compound cylinder. It is said that by the use of a modern boring mill of this kind 11 hours can be saved on each three-chamber compound cylinder, where it used to take from 8 to 10 hours to bore a simple cylinder. One of these cylinders can now be bored in three hours on this machine, thus making a saving of 5 hours on each simple cylinder bored.

The American Locomotive Company report that they have recently received an order for two consolidation or 2-8-0 type of freight locomotives with cylinders 20 x 28 ins. and weighing 184,000 lbs., for the Eastern British Columbia Railway Company, and also that they have an order from the Central Northern Railway of the Argentine Republic for ten 10-wheel freight locomotives of the 4-6-0 type, having cylinders 15 x 22 ins. and total weight in working order of 82,000 lbs. and 20 Pacific, 4-6-2 type, passenger locomotives having cylinders 17 x 26 ins. and total weight in working order of 114,000 lbs.

The "Progress Reporter," issued by the Niles-Bement-Pond Co., New York, not only furnishes a most interesting compendium of the machines manufactured by this company, but it sets a high water mark in the matter of illustrations. The twenty pages of the issue before us contain no less than twenty-seven of the best illustrations of machines that we have ever seen. They embrace combination slotting, boring, drilling and milling machines, car wheel lathes, driving wheel lathes, forge and engine lathes, milling and locomotive rod-fluting machines. There are several varieties of spline milling machines, besides illustrations of cutters and grinders.

CONTENTS.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

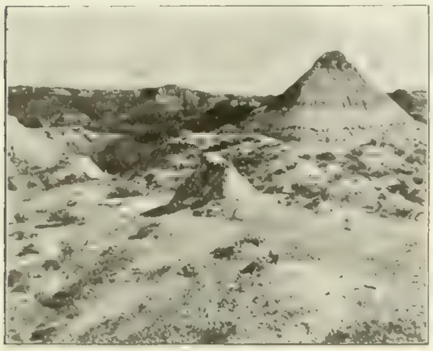
Vol. XXI. 114 Liberty Street, New York, October, 1908 No. 10

NORTH COAST LIMITED ON UP-GRADE BETWEEN ST. PAUL AND MINNEAPOLIS. NORTHERN PACIFIC RAILWAY.

The North Coast Limited.

The Northern Pacific Railway is, as its name implies, the most northerly of the great transcontinental lines in the United States. It connects the cities of St. Paul, Minn., with Portland, Ore., and is also called the Yellowstone National Park Route. The distance between these two cities is 2,052 miles and the North Coast Limited, Train No. 1, traverses the distance in 68¾ hours, according to the timetable. There are, however, two changes in time, one at Mandan, N. D., where on the West-bound trip one hour must

be added for mountain time, and at Trout Creek, Mont., the Pacific standard time adds another hour. The actual running time of the train is, there-



PYRAMID PARK. NO. PAC. RY.

fore, 70¾ hours, which gives an average speed of very nearly 30 miles an hour.

The equipment of the train is well up to the high standard maintained on our Western lines. This train was placed in service during 1900 as a summer train, but the demands of travel almost immediately necessitated its operation during the entire year. It is broad-vestibuled, steam-heated and electric-lighted throughout. It consists of a postal car, dynamo and baggage car, smoking car, first-class coaches, tourist sleeping car, dining-car, Pullman standard sleeping cars and an observation car of attractive design and accommodations. The interior finish of the entire train is of mahogany. The color scheme is worked out in harmonious green and gold shades which leave a pleasant impression. Each train has more than 300 electric lights, two of which are placed in each section of the standard sleeping cars and may be turned on or off at will. Each "limited" train weighs complete 418 tons and the engine and tender weigh 180 tons, making a total of 598 tons. The engines are 4-6-0, heavy fast passenger machines.

The Northern Pacific Railway runs through the Northwest States of the Union, Minnesota, North Dakota, Montana and Washington. It passes near the Northern boundary of Wyoming, in the northwest corner of which is the famous Yellowstone National Park. There is a branch of the road at Livingstone, in Montana, which takes the traveler to the entrance of this wonderful region at Gardiner.

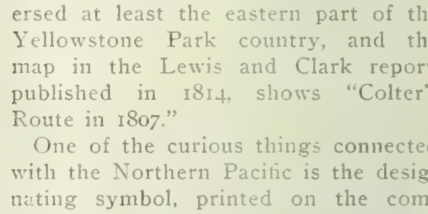
At the beginning of the last century not much was known about the northwest portion of the United States. In fact, the government had at that time no definite claim to the region, and President Jefferson recommended to Congress that an expedition be sent out to explore the headwaters of the Missouri River. Jefferson's private secretary, Meriwether Lewis, was appointed with Captain William Clark to conduct the expedition. In 1803 the party, consisting of twenty-eight men, was organized and they set out in the

FORT ROCK OF LEWIS AND CLARK. NO. PAC. RY.

Spring of 1804. In the following year the Lewis and Clark expedition reached the headwaters of the Missouri. This great river is formed by the union of three large streams, the Jefferson, the Madison and the Gallatin. These meet at the foot of the Gallatin Valley at a place known as the "Three forks of the Missouri." The actual junction point of these rivers is called the Lewis and Clark rock and is, historically, the most interesting. This point has always been kiown as the Three Forks of the Missouri, and the three streams just mentioned come together, two of them at the head of the rock and the third circles the rock on the east side and joins its volume to the other two at the foot of the rock. It is a very interesting region. The stream seen in the picture is the Gallatin River, which flows through one of the most prolific and beautiful valleys of the West. The view which forms one of our illustrations is taken from the high ground opposite and shows the figure of a man with arm extended pointing directly to the rock at the confluence of the rivers flowing from the heart of the Rocky Mountains and destined to reach salt water in the Gulf of Mexico. Lewis and Clark were the first explorers to reach the Pacific by crossing the continent north of Mexico.

The Yellowstone National Park was established by the government in 1872. Subsequently a Forest Reserve was added on the east and south sides. The park proper is about sixty-two miles long from north to south, fifty-four miles wide, and has an area of 3,312 square miles. It is mostly in northwestern Wyoming, a narrow strip being in Montana and Idaho. It is situated about midway between St. Paul, Minneapolis and Duluth on the east, and Seattle, Tacoma and Portland on the north Pacific coast. The park is an elevated plateau surrounded by mountains and has an average elevation above sea level of about 7,500 feet. Large streams of lava have spread over the park, and these have been greatly modified by glacial action and the erosion of rivers. The first man to see and know any portion of what is now the Yellowstone Park, was John Colter. Colter had been with Lewis and Clark to the mouth of the Columbia River, and on the return in 1806 severed his connection with those explorers and retraced his course to the headwaters of the Yellowstone. During the Summer of 1807 he traversed at least the eastern part of the Yellowstone Park country, and the map in the Lewis and Clark report, published in 1814, shows "Colter's Route in 1807."

One of the curious things connected with the Northern Pacific is the designating symbol, printed on the company's time-tables, folders, stationery and even forming part of the corporate seal. Many have wondered whether the peculiar design used by the company was adopted by them in a haphazard manner, or whether a real



LAKE PENDQUILLE. NO. PAC. RY.

significance attaches to it; whether it is simply an ingenious geometric device, or whether in its origin, meaning and adoption there is hidden a story.

Part of the story of the origin and meaning is thus told by Mr. Olin D. Wheeler writing for the railway. The tale runs that "In A. D. 1017 a young Chinaman, Chow Lien Ki, was born. As a young man he delighted in nature, and roamed the hills and dales. One day in his rambling he found a cave. The cave ran through a hill and had an entrance on each side of it. Both entrances were double crescent shaped, but the cave itself was round as a moon inside. Out of these cresentic entrances and the moon shaped cave he evolved the diagram that has become noted among the Chinese. This diagram, the Great Monad, he used to illustrate a system of philosophy established by Fuh Hi more than 3,000 years B. C., and, of course, 4,000 years before Chow found his wonderful cave."

The original significance of the two commas, as they really are, enclosed in the circle, seems to be emblematical of light and darkness. The Chinese century, if we may so call it, or the cycle of Cathay, consists of 60 years, each with a separate name. These were arranged round the Monad, which represented the dual forces, the Yin and Yang, which symbolized light and darkness. These form the starting-point of Chinese philosophy. It is practically the idea of the positive and the negative in nature, of which good and evil, heat and cold, strength and weakness, are a few examples. Spaces, each representing one year, with its distinguishing name, are evenly spaced around the Monad and thus pictorially represent the cycle of Cathay.

Tennyson, in his "Locksley Hall," "march of mind, in the steamship, in the railway, in the thoughts that shake mankind," glories in the rich promise of the future as revealed by what has already been accomplished in the past.

YELLOWSTONE RIVER IN "YANKEY JIM'S" CANYON. NO. PAC. RY.

"Through the shadow of the globe we sweep into the younger day;
Better fifty years of Europe than a cycle of Cathay."

The symbol, though it has no definite connection with a large modern railway, nevertheless lends itself easily enough as a distinguishing badge for a railway such as the Northern Pacific contrasting the older, and to us, less advanced civilization of the Western world with that of the nations who had prospered by what he calls the

FLATHEAD INDIAN RESERVATION. NO. PAC. RY.

where one might say contrasts are many and vivid. It takes its place as the symbol of a great transportation company. Light and darkness, force and matter, motion and rest, fire and water, all are contained within this mysterious figure, and all are so closely related in the calling for which the emblem stands. Day and night the freight and passenger trains of the Northern Pacific Railway, through the agency of fire and water, are in rapid motion and again at rest throughout the mid continent regions of the great republic of the Occident.

Steam Motor Car for the C., R. I. & P.

The Schenectady works of the American Locomotive Company have recently completed a 250 h. p. compound steam motor car for the Chicago, Rock Island & Pacific Railroad, the general appearance of which is shown in our illustrations. The car body is of steel throughout, with the exception of the interior finish. The car is divided into three compartments, an engine room, baggage room and passenger compartment, having a seating capacity for 40 passengers. This last compartment also includes toilet facilities.

The car is 55 ft. [illegible] long over platforms, and weighs in working order 100,000 lbs. Of this weight [illegible]300 lbs. is carried on the leading truck and 61,700 lbs. is on the motor truck, of which 32,400 lbs. is on driving wheels. On test runs made on the [illegible] tracks of the New York Central Railroad, the car has shown its capacity for high speed, and on several of [illegible] speeds of [illegible] miles an hour were made.

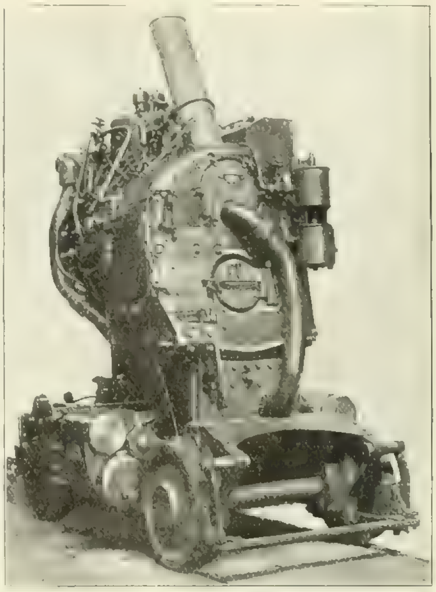
In the design of the car body which was built by the American Car & Foun-

dry Company, the aim was to make it as light as possible consistent with great strength. With this object in view, therefore, the truss rod construction was employed instead of following the more usual practice in the construction of steel cars of making the side frames below the window plate in the form of a girder or truss of sufficient strength to carry the whole weight of the car. The side posts are rolled steel angles riveted at the bottom to the side sills, and at the top to the side plate angles, which extend in one continuous piece the entire length of the car, on each side, and are bent at ends to the shape of the end of the car. The carlines are steel channels, bent to conform to the contour of the roof, which is of the round type.

The side sills, consist of 6 x 4 x 1½-in. steel angles reinforced by 1½-in. truss rods and the center sills are 8-in. I beams. For a distance of 30 ft. back from the front end, the side sills are reinforced by 6 x 4 x ½-in. angles riveted to the sills in such a manner that the horizontal leg is uppermost furnishing a bearing surface for the floor of the engine room. The end sills are 8-in. steel channels securely fastened to the side sills by means of wrought iron corner plates and to the center sills by angle connections. A number of steel angles, fastened to the side sills and center sills by angle connections tie the centre and side sills together between the bolsters. These cross braces also serve as supports for the floor.

The bolster at the trailer end of the car is of the built-up type, while that at the motor end is of cast steel, made in three sections so that the middle section may be readily removed to permit of the boiler and engine being drawn out from the end of the car. The middle section of the front end framing of the car body and the flooring ahead of the engine are also made removable for this same purpose.

The floors of the passenger and baggage compartments consist of two layers of wood, the upper layer being laid diagonally across the car, while the floor of the engine room is of steel with wood



END VIEW OF BOILER AND ENGINE.

covering; the section ahead of the engine between the center sills, being as before mentioned, removable. The inside sheathing of the passenger and baggage compartments is of mahogany and the head lining is fire-proofed board. Light is provided by five pairs of oil lamps hung from the center of the car, there being four pairs in the passenger compartment and one in the baggage room.

The car is equipped with spring buffer and M. C. B. single spring draft rigging.

In the design of the boiler the problem of providing the required amount of heating surface within the necessarily limited space available has been very satisfactorily solved. The boiler is of the horizontal return tube type. The fire box and smoke box are at the front end and the gases of combustion pass through the few tubes to an intermediate smoke box chamber at the back end, and thence forward through the return tubes to the smoke box. The barrel of the boiler, which is in one sheet 61⅜ ins. long, measures 49 ins. in diameter inside at the fire box end and 44 ins. in diameter inside at the intermediate smoke box end. It contains 214 fire tubes 1¼ ins. in diameter, and 3 ft. 9 ins. long and an equal number of return tubes of the same diameter, but 3 ft. 11½ ins. long. The total heating surface of the boiler is 624.4 sq. ft., which gives 2.5 sq. ft. per horse power. Of this heating surface, 527.8 sq. ft. is in the tubes and 37.6 sq. ft. in the fire box and the remainder in the superheater.

The fire box is 33⅛ ins. long and 43¼ ins. wide and is bricked for burning oil. The oil burner, which is in the fire door, is of special design and is provided with a fan shaped deflector which directs the oil downward toward the hot fire bricks and also spreads it out over the fire box, thereby tending to produce better combustion. The superheater is of the smoke box type and is in the intermediate smoke box chamber where the temperature of the gases is high. The superheater tee head is bolted to a cast steel box saddle casting which in turn is bolted to the top of the boiler, and covers the opening cut through the sheet by which the superheater tubes extend down into the smoke box chamber. The tee-head is divided transversely into a front and a rear compartment by means of a vertical partition. There are sixteen superheater tubes bent into the shape of a double loop, one end of each loop being connected with the front or saturated steam compartment, and the other end with the rear or superheated steam compartment. Steam flows from the dome through a short dry pipe into the saturated steam compartment; and thence through the superheater loops into the superheated steam compartment, and from thence into the

STEAM MOTOR CAR FOR THE CHICAGO, ROCK ISLAND & PACIFIC.

W. A. Nettleton, Genl. Supt. of Motive Power. American Loco. Co. Builders.

steam pipe to the high pressure steam chest. The boiler is rigidly connected to the motor truck frames, so as to eliminate the necessity of flexible steam joints. The engine is of the two cylinder cross compound type, the high pressure cylinder being 9¼ ins. in diameter by 12 ins. in stroke, and the low pressure cylinder, 14½ ins. in diameter, by the same stroke. The Mellin system of compounding is used, the intercepting valve being in the high pressure cyinder casting. Both cylinders are equipped with piston valves actuated by the Walschaerts valve gear. The cylinders are in separate castings and are rigidly bolted to the side frames of the motor trucks. They drive on the rear wheels of the truck, which are 38 ins. in diameter. With a boiler pressure of 250 lbs. the engine will develop a theoretical maximum tractive effort, working compound, of 4,300 lbs.

The motor truck is of the four wheel swinging bolster type. The side frames, which are of cast steel, are 3½ ins. wide, and are rigidly tied together by the cast steel transoms and by cross ties suitably placed. The bolster is carried on double elliptic springs. The weight on the rear or driving journals is carried by a semi-elliptic spring, suspended between two cross equalizers whose ends rest on top of the journal boxes, while the weight on the forward journals is carried by coil springs, one on top of each journal, thus giving a three-point suspended truck. The trailer truck is of the four wheel, two bar equalizer type, with solid wrought iron top frame, swinging bolsters of the built up type, channel iron transoms and cast steel transom gussets. The wheels are 34 ins. in diameter and the journals are 4¼ x 8 ins. Both motor and trailer trucks are equipped with New York Air Brake Co.'s air brakes operated by an 8-in. Westinghouse pump. New York air signal equipment and Gold steam heating equipment is also provided. The oil for fuel is carried in a tank in the engine room and having a capacity of 100 gallons. The water supply is in three tanks, having a total capacity of 1,000 gallons, suspended beneath the car midway between the trucks.

The principal dimensions of the car are as follows:

Total weight, 100,000 lbs.; weight on leading truck, 61,700 lbs.; weight on drivers, 32,400 lbs.; weight on leading wheels, 29,300 lbs.; weight on rear truck, 38,300 lbs.

Total wheel base, 45 ft. 10 ins.; distance between truck centers, 38 ft. 3 ins.; wheel base of driving truck, 8 ft. 4 ins.; length of car body over sheathing, 52 ft.; length of car body over platform, 55 ft. 9 ins.

Diameter of Cylinders.—High pressure, 9¼ ins.; low pressure, 14½ ins.; stroke, 12 ins.; valves, piston; valve gear, Walschaerts.

Wheels.—Driving, diameter, 38 ins.; leading, diameter, 33 ins.; rear truck, diameter, 34 ins.; journals, driving, 6x12 ins.; journals, trailing truck, 4¼x8 ins.

Boiler.—Outside diameter at intermediate smoke box end, 444 ins.; fire box, length, 33⅛ ins.; fire box, width, 43¾ ins.; tubes, diameter, 1¼ ins.; tubes, number and length, 214, 3 ft. 9 ins.; 214, 3 ft. 11½ ins.; heating surface, tubes, 527.8 sq. ft.; heating surface, fire box, 37.6 sq. ft.; heating surface superheater, 59 sq. ft.; heating surface, total, 624.4 sq. ft.

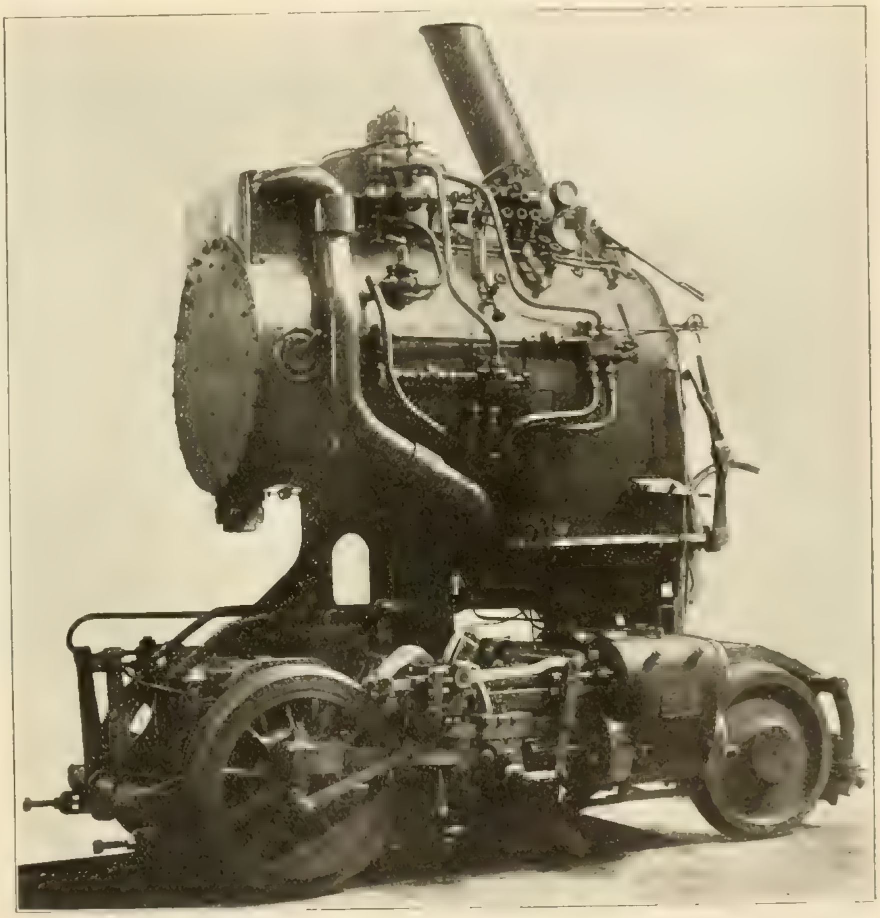
On the Lehigh Valley Railroad.

There is a world beyond the Alleghanies, and its development is owing largely to the steam locomotive. Less than a hundred years ago this was a trackless wilderness. The steam engine, and more particularly the locomotive, has changed all this. The shining path of the iron horse is now in every valley, and along by every stream, the tide of traffic rolls as on the wings of the wind.

It is a wonderful panorama that passes before the eyes of the traveler on American railways, and it is a rare pleasure to leave the city with its miles of brown and red and white walls and look out upon the green fields wreathed in the glow and glory of the early Autumn. Mountains broad-based and laurel-crowned rise as by the touch of an enchanter's wand. Dark forests, solemn as cathedral aisles, golden fields and grassy knolls sprinkled with daisies, pass in rich and spangled beauty. There the shining Lehigh River spreads far and wide and still as a burnished mirror, with all the wonders of heaven and earth reflected in its crystal depths. There it lingers under the dark branches of spreading pines. In the dim shade the primrose blooms. Aloft the fiery finger of October is transfiguring the leaves to variegated vermillion.

As we approach the classic valley of Wyoming a stirring wave of human interest comes into the vision. Farm buildings, foundries, hamlets half-hidden, clustered villages, busy towns, and presently the noble Susquehanna, shining in silver majesty. There is something of the substantial dignity of the metropolis about Wilkes-Barre. The city is finely set in one of the richest valleys of the world, rich in agricultural and mineral wealth, rich in industrial enterprise and rich in the great arteries of traffic which converge there. The clang of the locomotive bells are accompanied by the rattle of the heavy-laden trains that pass and repass in every direction. We pass a dozen thriving towns set by the banks of the Susquehanna, and presently we are at Sayre, the great workshop of the Lehigh Valley Railroad.

The cluster of buildings forming these extensive workshops are among the largest in the world. The main shop is 750 ft. in length by 360 ft. in width. There is accommodation for over 60 locomotives undergoing general repairs. Every modern appliance used in the construction and repair of locomotives is there, from the 150-ton cranes that traverse the vast building to the smallest kinds of needle drills. The larger lathes are all of the electrically-driven kind, as also are the larger planing



THE "MOTIVE POWER DEPARTMENT" OF THE CAR.

machines and drill presses, the smaller variety of machines being driven from shafting that runs in parallel sections of 100 ft. in length. A notable feature is the number and variety of compressed air-driven tools, nearly all of the boiler work being done by tools of this kind.

A new and important addition to the boiler department is the establishment of a vast circular well into which the entire shell of a boiler may be suspended by a giant air hoist and any part of the boiler may be readily placed against a strongly supported column adjacent to which is a compression ram. Here the heated rivets may be placed in the rivet holes and one stroke of the sliding ram makes the rivet heads take shape. The rapidity with which two men and a boy can handle such ponderous work is surprising. The numerous attachments of a new fire box can be secured in place in an incredibly short time.

It was particularly gratifying to note the orderly arrangement of material in the store-rooms and yards. The 36,000 horse power engines are of the vertical kind common in marine service and their noiseless operation shows how perfectly adjusted their attachments are. We observed that changes were being made in the fire-rooms, the original self-feeding furnaces being replaced by those of the ordinary open furnace, hand-fired kind. It appears that the liability to get out of order on the part of the automatic stokers was the cause of the return to hand-firing.

During the period of business depression through which the country has been passing it is pleasing to learn that the Lehigh Valley Railway Company has acted in the most generous manner towards the army of skilled mechanics at Sayre. There has literally at no time been any dismissal or suspension from work. In some departments there has been a shortening of the hours of labor, and in others a limitation of the quantity of piece work. This has given rise to no spirit of discontent, and now that a marked improvement in railway traffic has set in, every indication points to a resumption of fullest activity.

We cannot close without alluding to the elegant and commodious dwelling houses built by the company for the accommodation of the railway men. Of these there are many hundreds set in delightful surroundings of trees, each with its separate lawn and garden. These houses are rented to any employee desirous of doing so, the matter being purely optional. The rents are from eight to twelve dollars a month. Our visit was too brief to examine the interiors of the various kinds of houses, but to a dweller in a city flat a feeling of envy came nearly choking us. When we go back to work in a railroad shop may our lot be cast among the social, kindly men and happy homes that bless and beautify the city of Sayre.

POPOCATEPETL MOUNTAIN, ON THE SAN RAFAEL & ATLIXCO RAILROAD, MEXICO.

In a very interesting paper by Mr. W. E. Symons, published in a recent issue of the Journal of the *Western Society of Engineers*, he discusses "the passing of the steam locomotive." It is hardly necessary to say that the author of the paper has used this title not from any conviction on his part that the locomotive is passing away, but rather to deal with what one might almost call the flippant phrase which is often used by thoughtless or ignorant people or even by people whose interest may lead them to wish that the phrase was literally true. Mr. Symons goes into the growth and history of the iron horse and shows that the "passing" of this form of motive power is still in the dim and distant future.

He quotes Mr. Frank J. Sprague, one of the principal promoters of electric transportation in this country, as having given utterance to one of the most sober and rational views of the whole subject of steam and electricity. Mr. Sprague is quoted as follows: "Let us lay aside, then, some of the visionary prophecies concerning electric railways with which probably no one has been more closely identified than myself; no one has greater faith in the electric railway than I, but its future is not in the wholesale destruction of existing great systems. It is in the development of a field of its own with recognized limitations, but of vast possibilities: it will cover such field to the practical exclusion of all other methods of transmitting energy; it will replace the steam locomotive on many suburban and branch lines; it will operate almost all street railway systems and elevated and underground roads; it will prove a valuable auxiliary to Trunk Systems, but it has not sounded the death knell for the steam locomotive any more than the dynamo has sounded that of the stationary engine; each has its own legitimate field, and will play its proper part in the needs of all civilization."

Reports of the progress of work on the prairie section of the Grand Trunk Pacific show that the material for the round house at Wainwright is on the ground and excavation work started. At Watrous the wall foundations, engine pits and pedestals are completed. The bridge over the Assiniboine River near Lazarre, is practically completed.

Characteristic Epitaph.

Engineers' epitaphs are scarce. Here is one that may be seen on a tombstone in Bromsgrove Parish Churchyard, England. A sketch of an engine is carved on the stone. It is to the memory of Thomas Scaife, engine driver, who was killed in a boiler explosion at Barnt Green Station, November 10, 1840:—*Montreal Witness.*

My engine now is cold and still,
No water does my boiler fill,
My coke affords its flame no more,
My days of usefulness are o'er.

My wheels deny their noted speed,
No more my guiding hands they heed;
My whistle, too, has lost its tone,
Its shrill and thrilling sounds are gone.

My valves are now thrown open wide,
My flanges all refuse to guide;
My clacks also, though once so strong,
Refuse to aid the busy throng.

No more I feel each urging breath,
My steam is now condensed in death;
Life's railway's o'er, each station's past.
In death I'm stopped, and rest at last.

General Correspondence

Flue Sheet Bracing.

Editor:

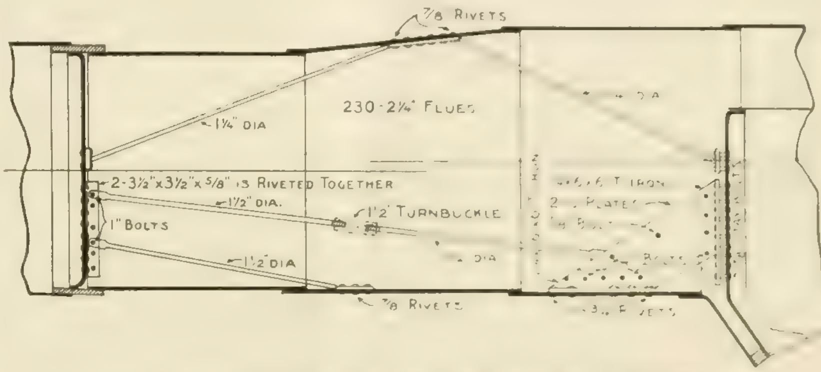
The article in your July number on the "Care of Boilers and Flues" gave some valuable information concerning experiments that were made of unequal expansion between the boiler and the flues.

Accepting all that has been said on this subject of leaking flues and the causes therefore, we are still dependent on the proper care and handling on the road, at the ash pit and in the shops for better results or a partial remedy of this almost universal trouble, or what appears to be, in general, the summing up of all discussions that have been had on this question.

The proper and prescribed methods as laid down we hardly can expect to get at the present time, especially when pushed to meet the demands as we were during the [illegible] pressure of prosperity when efficiency was very low and help scarce. Therefore, to profit by past experiences and to free ourselves from being dependent upon common labor to carry out detail instructions, we should look for a remedy of flue troubles by, if possible, departing from past practices and improve methods.

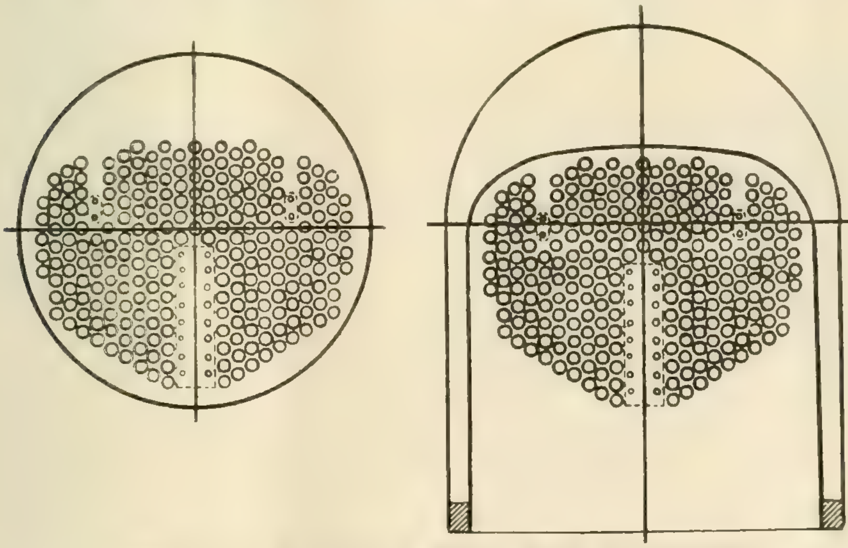
We have been following the present practice of flue setting for the past quarter of a century and requiring the flues to act for the purpose of carrying off gases and radiating heat and also to act as braces for the flue sheets. This function the flues performed when 140 pounds was the steam pressure and the flues were not twenty feet long but now with increased steam pressure of 200 pounds or more and an additional length of flues it is more than the flues can be expected to stand, and, accepting the figures in the article of July before referred to, showing the unequal expansion between the boiler and necessarily the back and front flue sheets and the flue, and we know such inequality exists regardless of the exact amount brought about when cleaning fires on the ash pits or injecting cold water when the engine is standing and other causes. Knowing this unequal expansion does go on and that it is one of the laws of expansion and contraction that we cannot overcome we must accept it and give it freedom and change our methods to meet the demands, and make the holding of flues tight in the sheet regardless of road and shop abuses as much as possible.

As before stated, the flues must be relieved of the responsibility of acting as a brace for the flue sheet and the sheets properly braced to the boiler so they will not bulge or have any diaphragm action but remain in permanent set. The flues [illegible] ion to the boiler and [illegible] This might appear [illegible] period of depending on the beads to the flues for the proper form, depth, etc., but,



BOILER BRACING TO [illegible]

[illegible] former tests that have [illegible] showing that the flue contracts [illegible] more than the boiler and that the movement of the flue by pushing and pulling action takes place in the [illegible] the fire box, the flue shortens consequently pulls on the bead and endeavors to pull the bead through the sheet, more or less; this causes the circumference of the flue to decrease as the strain exerted on the bead contracts the flue in its fit in the sheet and has a contracting action, consequently when the flue again expands to its normal length it is loose in the sheet and is leaking.



FRONT AND BACK VIEWS OF BOILER BRACE ATTACHMENTS.

I do not agree entirely with some previous arguments that the admission of cold water or the injection of cold water contracts the lower flues in their diameter fit in the flue sheet on account of the thickness of the flue being so much less than the flue sheet and will contract to a greater degree. It is admitted that the cause of flue leaks is due to contraction but this is brought about by a longitudinal contraction which imparts the strain on the flue end at the back flue sheet setting and is not caused entirely by a temperature contraction.

This strain has been so great that it is common to insert a hand hammer handle in a flue that has been leaking badly and move it in the sheet. Therefore, without the beads to bring about this strain and allowing the flue freedom to move leaks may not be entirely over-

come but what leaking does occur will give no serious trouble.

One method of flue sheet bracing is given on the enclosed sketch. This requires the sacrificing of about twenty flues but although this engine has been running for the past ten months no preceptible difference is noticed in the steaming of this engine due to the loss of the flue heating surface over other engines of the same type with a full complement of flues. There are other methods of bracing equally as good and some do not require the taking up of any of the flue space, the writer having in mind the "Auxillary Flue Sheet" which has been fully explained in previous "mechanical journals." J. S. PEARCE,

Master Mechanic Norfolk & Western.
Portsmouth, Ohio.

The Murphy Stereopticon Method.

Editor:

The matter of safe transportation has grown to be so important that our great railroad lines have come to realize that something must, can and shall be done in order to lessen the danger of travel by rail, to eliminate as far as possible the immense loss and damage by accident which has for so many years gone to swell their expense accounts to such an enormous amount.

Thus from day to day, month to month, and year to year, we have drifted along with the current of time, consoling ourselves with the thought that all this was "unavoidable," and must be endured, for, as long as there are railroads, there will be accidents, and where there are accidents there also is loss of life and property and consequently a very large expense account as the inevitable result.

During many years of his active and very successful railway career, there was at least one man who was wide awake to the importance of this great subject. This man was the late W. J. Murphy, who was vice president and general manager of the Cincinnati, New Orleans & Texas Pacific Railroad. Realizing the fact that a world of railway appliances already in successful operation had not proved more than a single step in the direction of decreasing the fearful calamities which were still of frequent occurrence, it occurred to him that the secret, in all probability, rested largely with the employee, individually and collectively. The problem thus presenting itself was not easy of solution, indicating as it so plainly did, the great need of some new and practical method tending toward the education of the railway man in his daily duties.

A large number of the C. N. O. & T. P. men he knew personally and was convinced that they were good men, that any railway company might feel proud of. He was still more strongly convinced that the old practice of dismissing such men from the service for apparent infractions of rules was not only unjust and cruel to the men, but was fraught with deadly results to the interests of the company. He found that letting old and experienced men go and replacing them by new, had the effect of producing the very same results as before with no prospects of improving the situation. Reasoning along these lines, the idea of a higher education of his men in their daily and practical duties seemed to burst upon and impress him to such a degree as to leave no doubt in his mind that he had at last found a solution if it could be made practicable.

At first he tried the written examination. There were upwards of three hundred questions requiring written answers. These question were printed and put up in pamphlet form with space left blank for the answers. His idea was to bring out the true worth and accomplishments of the applicant in an educational manner and make use of this as a basis for judging the fitness of the man. These applications were filled out, not only by new men entering the service, but by all men in the Transportation Department, no matter how long they had already been in the service. The men were brought in to headquarters and were required to give up their book of rules and fill out the code of questions without reference to the rules. No information was to be asked as a help to the answers, they were to be the product of the individual mind and were to form the basis for an official decision as to the man's fitness to enter or to remain in the service of the company. This method was followed for several years and while it was helpful and served to instill a new interest in a comprehensive study of the rules on the part of the men, it was also found that many of the questions were necessarily long, and ambiguous to not a few, therefore hard to interpret and not understood alike by all, failing to produce the standard of excellence which it was desired should prevail on a well regulated railway. Mr. Murphy, wide awake to the interests of his men as well as to his company, saw man after man failing on this test. Many of them were men he knew well and admired, as much for their honesty as for their integrity. They were all right and he could not afford to lose and was determined not to lose them.

Here another obstacle presented itself. It was admitted that the mthod was good, that many men had been forced to brighten up on the rules and that much real merit had been visibly manifested in all, but the fear still lingered that men would again fall into the same old rut, and another examination would be necessary. This was admitted even by the men themselves and was a source of great perplexity, but the same brilliant mind ever eager to push on and save his "boys" was preparing a surprise for them.

INSTRUCTION CAR FOR THE MURPHY METHOD, UNION PAC. RY.

He had been working secretly but persistently and untiringly for a long time with the view of producing some method by which he could reproduce or "vivify," as it were, the rules into the minds of his men, producing a lasting impression, not alone of the simple rule itself but picturing its meaning and application upon the mind and imprinting and planting it deeply and firmly into the heart. His idea was to make this exceedingly attractive to the men. To accomplish this he ordered that the "School," or lecture room, should be perfectly free to all and open discussion without the slightest reserve should be encouraged rather than restricted. The brakeman, fireman, conductor and engineer were all on the same footing with the superintendent or the general manager pending all discussions or debates upon rules, customs, theme or practice, or any topic of any nature whatsoever having for its object the interests of the railway company or its employees while upon the floor of the lecture room.

Men crowded into these "Schools" no matter how tired, sleepy or hungry they were and each helped to enliven the audience by some valuable idea brought to light by practical experience. Many such ideas originated from the brakemen and firemen or some one else among the rank and file, and due credit and commendation was given in each case. This feature of the method is one of its most valuable

adjuncts, being a source of much important information concerning actual practice and personal experiences with recommendations, suggestions, etc., that was scarcely obtainable in another way. Men in the ranks appreciate this and are constantly spurred on with renewed interest, each becoming a vigilant watcher of the other in the actual performance of their daily duties. They are always on the alert looking out for and constantly grasping every item of new material to be used at the next "School." They vied with each other in these respects, always in the best humor and kindly feeling producing results in many instances that would do honor to those much higher up the ladder of fame and success. Recognizing all these features from a long and varied experience in all branches of railroading, I am sure it will be admitted that to this gentleman is due a world of honor as much by the train and engine men all over the country as by the railway companies and the traveling public, to say nothing of those who have large investments in railway property.

When the message passed over the wires telling all employees who could possibly be spared from duty to report at his office upon a certain Sunday, some fifteen or sixteen years ago, there was great excitement and wonderment as to what the "Old Man" had up his sleeve now—every one was anxious to go and be at the opening of this great surprise. Special trains were run and extra coaches attached to other trains for the accommodation of all who could attend. Much guessing was indulged in and many jokes were cracked, some thought that there was a general reduction in salaries to be announced, while others feared there would be many heads dropped as a means of curtailing expenses, to which the "Old Man" was known to be always wide awake and exceptionally alert. Many there were, however, who had more faith and could not bring themselves to believe that there was any reason for serious apprehension, but thought it might be a "Helping Hand" from the "Old Man."

The doors and windows were closed, thereby darkening the room until it was difficult to see. Presently an electric light wire was connected with an instrument which had been standing in the middle of the room, and a second later there burst forth upon a large canvas stretched against the distant wall the flash of a magic lantern, disclosing in unmistakable terms and producing a most inspiring scene, the "W. J. Murphy Stereopticon Method" for examining and instructing employees. There was truly and really the "Helping Hand." The men sat there in astonishment, witnessing and thoroughly understanding without the slighest difficulty the many problems exhibited upon the canvas which had so often perplexed them during the past two or three years. It was photographing an "idea"—taking the picture of a "thought"—"reproducing a memory by machinery." It was wonderful, though simple.

Show me the "A. B. C." system, or any other system, and if a picture can be taken of its rules, methods, appliances, or instructions, I can prove to you that the "W. J. Murphy Method" can be admirably applied, rendering it plainer, more easily, more rapidly and more thoroughly understood, and making it decidedly better than before. There is no possible system for the safe movement of trains, the operating of signals, the examination and instruction of men but that the "Murphy Method" can make it better. This method is cheaply arranged for, first cost amounting to very little, but would be well worth its price at any cost. Among the pictures from the Union Pacific Railway, who are using the "Murphy Method," the first is the exterior of an ordinary old coach which has been fitted up at cost of about $150.00. The other one is of the interior of the same car.

INTERIOR OF UNION PACIFIC INSTRUCTION CAR.

Mr. J. G. Matthews, an old train dispatcher, is Chairman of the Board of Examiners, and when not out on line of the road his headquarters are at Denver, Col. Mr. Daniel H. Brees is the General Air Brake Inspector in charge of the "Air Car"—his headquarters are at Omaha.

There is little doubt that this will sooner or later become the accepted method for all well regulated railroads in this country. There is nothing that will so largely interest or so widely benefit the employee especially the train or engineman and the telegraph operator. No other system has been so far found that is so thoroughly explanatory or that can approach this method. Train men are eager for his system everywhere, they have heard and know of it by its reputation and influence. There has not been a passenger killed on the C. N. O. & T. P. Ry, where Mr. Murphy first put this system into service, for more than fifteen years. The "Murphy Method" has never been seen except to be admired; it carries its own inspiration and train men, the world over will always have a good word for the "Old Man" of the "Helping Hand." W. B. Blanton.

Sausalito, Col.

Historic Locomotives at Purdue.

Editor:

I have been reading with great interest an article on page 258 of the June number of this year headed "Historic Locomotives at Purdue." As the writer of this letter served nearly 27 years on the old Madison & Indianapolis railway as locomotive engineer and M. M. and often acted as engineer on what was at that time called the Inclined Plane, I would like to correct some of the errors of that history.

The "M. G. Bright," the first of the cog rack engines, was designed by Mr. Andrew Cathcart the master mechanic of the road, and he went to the Baldwin works and supervised her construction. It is stated in the history that often while

ascending the steep grade the cog would become disengaged from the rack and the entire train go thundering down the hill. There were several runaways of cars and a few of the engines down that hill, but never one of the "Bright" or "Brough" as described. There was a steam cylinder laid horizontally on the top of the boiler of each of these engines connected to the cog gearing for the purpose of putting the cog wheel in and out of gear, and when in gear the steam was let into the end of the cylinder to hold the cog wheel in gear, and as long as this remained intact it was impossible for it to become disengaged. These engines often hauled cars up the hill without using the cog rack, and were in service for about 20 years before the "Wells" was built, and before the "Bright" was built we had an 8-wheel connected Baldwin engine that was called "Columbus" that did all the work on the hill that was required, and after the cog rack was established the engines "Lannier" and "Gov. Whitcom" were often used on the hill. The peculiarity of the "Reuben Wells" was in having 5 pair of driving wheels and [illegible] tank arrangement, also large cylinders for the drivers. These old Madison & Indianapolis engines in those days were not considered cumbersome or detrimental to the business of the road, and the writer of this letter has often taken each of them down the hill depending entirely upon their adhesion to the rails and never had any trouble in so doing. The editor of the London *Engineering* could have been convinced 20 years before the "Wells" was built, that common engines could climb such grades.

BENT W. SMITH.

Crude Oil Frame Weld.

Editor:

I take pleasure in sending you a photograph showing "Preparation for a Double Frame Weld with Crude Oil" which we successfully welded without removing the frame from the engine. I also send two sketches. Fig 1 shows the appearance of the broken frame;

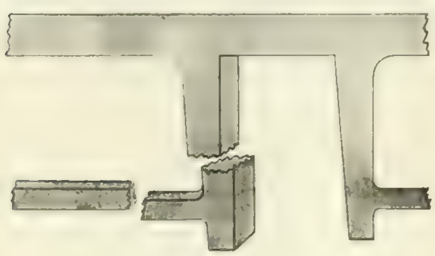
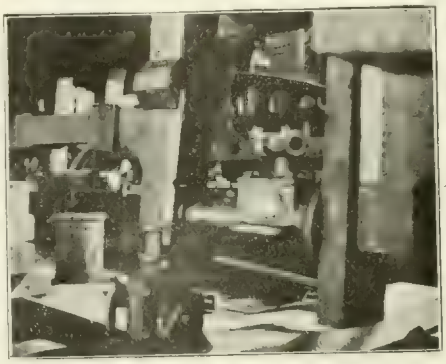


FIG. 1. BREAKS IN FRAME.

and Fig. 2 shows the preparation of frame.

This represents the right-front jaw, welded on back the leg and bottom rail. After the break was prepared for welding we welded the leg, then we put the pedestal bolts in front and main jaws for the purpose of pulling the broken parts open on the bottom rail, then we applied the pieces prepared for welding, after this we made the weld in the rail. The cost for welding this frame amounts to $16.59.

It has been customary to remove frames from engines that were broken



WAITING FOR THE OIL FURNACE.

in this way, but by our method of Crude Oil Welding we have accomplished successful welding without removing the frames from engines. We have pleasure in giving the public an account of our successful work and money-saving plans.

C. H. VOGES,
Gen. Foreman Big Four Shops.
Bellefontaine, Ohio.

What We Know and Don't Practice.

Editor:

This may appear to many a trite subject to discuss after so many have aired it, and held it up to be viewed from all sides, and it is a trite subject, but it is hoped that its presentation at this time will be the means of awakening the dormant thoughts of some of the young engineers, and old ones too, of this country.

In our travels up and down, how many we meet that think that they have a "kick" coming, that think that they are not getting all that is coming to them, when in fact it is their own fault that they do not get on any faster, but they are too short sighted to see their own shortcomings. The writer once fired for a man who in every respect was nice for a companion, on or off the engine, but he did not "practice what he knew" and consequently he made firing a bugbear and drudgery.

He was in the habit of starting out with the boiler as full of water as it could be carried without throwing it out the stack and then he would let her get hot and blow off till there was only one gauge of water in the boiler. Then he would start the injector and try to fill the boiler up again and at the same time he would have her down in the third or fourth notch in place of the sixth or seventh, where, with 140 lbs. of steam, she would handle a full train for one engine, or push 20 cars of a double header in good style, and with ease for the engine and comfort for the fireman. It was all the same to Turney. If she was up to 140 and blowing off with the fire door open, or down to eighty with the injector wide open and hogging along with the lever down among the oil cans, he would look at the coal pile and laugh and ask me if I thought we could get to the next coal chute before the fuel was all used up.

After I had fired a few trips for Turney, he laid off for a rest, and a younger engineer that had only been set up for about ten days, caught the 264 on her next trip out. I was filling the side rod cups when young Anderson showed up with his overclothes and "chuck bucket" and my heart settled away down in my shoes when he told me that he was going out on my engine. For a few minutes I was undecided whether to quit or lay off sick, but I did neither and have always thanked my lucky star that I stuck it out, for Anderson's way of handling an engine was a revelation to me.

As I climbed up on the foot board after filling the oil cups, Anderson asked me a few question about the 264, how she was steaming; how Turney got along with her, how many cars he hauled, and how much coal she burned on a round trip.

I noticed that he indulged in a quiet laugh at some of my answers, and as he started to oil round, he made the remark that he guessed that we would get there, but I had my doubts about it just the same. While we were getting ready to pull out, Anderson kept his eye on the steam gauge and the water glass, and when we got the "dog house" and coupled

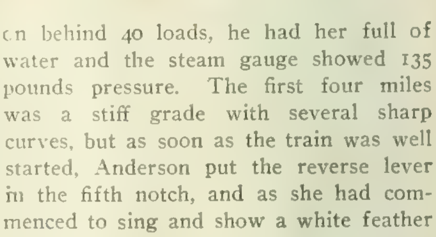


FIG. 2. READY FOR WELDING.

on behind 40 loads, he had her full of water and the steam gauge showed 135 pounds pressure. The first four miles was a stiff grade with several sharp curves, but as soon as the train was well started, Anderson put the reverse lever in the fifth notch, and as she had commenced to sing and show a white feather before blowing off, he put on the injector and as soon as she stopped singing, set it at the notch that would keep her from blowing off, but still let her stay hot.

I soon noticed that she was not burning her fire out so fast, and was not losing her steam pressure as she did when Turney was on her, but I was green and had not "caught on" to what a fuel saver a reverse lever was in the hands of the right man, but I did "catch on" to the fact that I was not shoveling so much

coal to keep her hot, and was therefore not working so hard to get over the road. When we got up the hill onto the level, she showed 140 lbs. of steam and two and a half gauges of water, in the water glass. As soon as the train was on the level the reverse lever was pulled back to the seventh notch, and kept there until we reached the foot of another grade. But it was not necessary for me to follow any farther. It was the same all over the road. Anderson watched her and took advantage of everything, she never blew off unless the boiler was as full as she would carry, and the gauge never showed less than 125 lbs.

Now, Mr. Editor, there may not be any new or important facts presented by my little serial, but the facts go to show that while Anderson practiced what he knew, Turney did not, and as we were employed by a company that paid engineers and firemen a coal premium, it has always been a mystery why Turney did not handle his engine in such a way as to get his share of the premium money. A few months after my experience with Turney, after I had fired long enough to get a good run and a new engine just out of the shop, my regular engineer laid off a few days, and it was my luck to catch a new runner making his first trip over the road after being promoted.

Kimball was a good hearted young fellow, but as the class of engine I was firing was new on that division, he had never fired one, and being promoted from a ten-wheeler he had never handled one of the "new hogs" and he was honest enough to tell me that he did not know much about them. The first train we took over the division was a stock train, and as Burdett and myself had made a good record for the 22 on stock trains, I did not like to give it up, but for my life I could not keep the 22 hot for Kimball. In a very few minutes after getting out of the yard I saw that he was not handling her like Burdett did, but as I was only a fireman, and he did not ask for any advice, I kept quiet, but as we reached the top of the first grade going at a snail's pace and with just steam enough to keep from stalling, the "Con" came over to the engine and wanted to know what was the matter. Kimball told him that the engine was a ——, and would not make steam enough to pull his hat off.

After a growl about losing time the "Con" told Kimball that if he could not make time over the road they would hear from the dispatcher about it. He then went on and told him about the runs that Burdett had made and finally wound up by telling Kimball that he did not know how to run an engine. By letting the train "fall" down the grades in our favor we finally got over the road without laying anything out, or hearing anything from the dispatcher. When we got in, I was about played out, and "all in." I found out there was an extra fireman at that end of the division and I asked the round house foreman for a lay off. It was granted, and as I left the office Kimball followed me out and wanted to know what was the matter that I was laying off. I told him that I was played out, sick and disgusted, that the trip with him was the hardest I had ever made over the road, and that I was going to lay off till Burdett came to work. He turned his eyes away and looked hurt. After a moment or two he turned back to me and said, "Frank, I have fired on this division three years and a half, I have passed my examination and been promoted, this is my first run as an engineer, and if I make a failure of it, I will be put on an engine to fire again and all of the young runners will be put ahead of me, and it will take me years to work up again. Burdett will be off for several days and I would like to hold the 22 down till he comes back, but if you are laying off because I don't handle the engine right, I will lay off too, for I won't go out on one of those engines with a green fireman. You are an old fireman and understand how to fire and handle them and if I did not handle her just right coming in, and you will go out with me next trip I will handle her just as you say and see if I can do any better with her."

BRAKE TEST TRAIN ON THE ARLBERG RAILWAY, AUSTRALIA.

I felt sorry for him, and his frank way of talking won my heart at once, and I felt hurt about the 22 coming in so near a failure, I went back and reported to go out on my engine on her next trip. When we met next day at the round house, myself and Kimball got up in the cab of the 22 and I showed him where to put the reverse lever when on a level to handle 30 loads, I explained to him the best I could how Burdett handled her all over the road. After I got through I said to him, "Now, Kimball, seeing is believing. I have told you how Burdett runs her and you know that we don't take a back seat for any engine on the division when it comes to getting over the road. Now just to show you what the 22 will do if you handle her right, I will fire her and run her ten miles to the top of the first grade and then you can have her." When we left the yard with our train, I had a good fire in the firebox and 135 lbs. of steam with three solid gauges of water in the boiler. As soon as we got a clear track I commenced to pick up the train, and as we had level track for four miles, when we struck the first five mile grade I had them rolling about 35 miles an hour with the reverse lever in the seventh notch. As she commenced to feel the pull of the 30 loads, I dropped her down a notch and at the same time eased the injector off a notch. When we reached the top of the hill and got on the level I had 130 lbs. of steam and two gauges of water to the good, when the train was on the level I pulled the lever back in the seventh notch, got down in the gangway, picked up the scoop to put in a fire, and gave Kimball a nod to take her. As he got over on the right side I gave the grates a shake, threw in a fire and closed the door. In about a minute the 22 was popping off with the injector on. You should have seen Kimball smile.

Here is another case in point: Mr. Pierce was acknowledged to be one of the best master mechanics that a man ever worked under, and a man had to do something out of the ordinary run of little misdemeanors, that engineers will be found doing sometimes, before he would say anything to him. There was a man on his road, an engineer by the

name of Smith. This man was noted for always being late getting around when called to go out, and as was to be expected, was always in a hurry oiling round and ready to start. One day Mr. Pierce was going through the yard where Smith was putting the oil on as if it was plenty as water and did not cost a cent. Smith as usual was late and in a hurry. He spied Smith and after watching him a moment, stepped up and remarked: "Smith, one drop of oil on those guides will run you farther than a pint on the ground." Smith looked foolish and stammered something about "being in a hurry." Mr. Pierce turned on his heel and walked away. Smith knew better than to waste oil that way, he knew better than to be late getting around after he was called. Yes, he "knew," but he did not "practice what he knew." And right here I wish to say to the young engineers, "Practice what you know." If you don"t know, then learn, and then "practice." Don't go over the road with the reverse lever down in the corner, "hogging it" along, for I have been through the mill, and I find that that a man that is a hog on an engine, is a hog off one.

FRANK PHELPS,
Fort Bayard, N. M.

Trip to B. C.

Editor:

Leaving Philadelphia in July with a locomotive, consigned to the "Western Fuel Co." of Nanimo, B. C., the distance being approximately 4,000 miles, I arrived in Chicago via L. S. & M. S. and transferred to the Wisconsin Central and arrived at Fond du Lac two days later. This is a beautiful city, and after having a good night's rest, I was off on Sunday morning for St. Paul. I was much amused to see everyone working, painters painting houses, people working in the fields and I was compelled to appeal to the train crew to know if it was Sunday. I wish to make mention of the fine water in the State of Wisconsin.

Arriving in St. Paul I was transferred to the Soo Line and at 4:00 a. m. was off on the great trip across the Canadian plains. The average passenger sits in a comfortable Pullman chair and allows the beautiful panorama of the great Canadian Northwest to glide by. It is doubtful if he gives a thought to the question of how this wonderful railroad was ever built. Anxious to obtain a better view of this great work I spent the greater part of my time riding on top of the caboose. I arrived at Enderlin, N. Dakota, on the 24th of July. This is the country of bad water. I was much surprised on hearing from the master mechanic of the troubles they had with the water. The water is so bad you could not boil an egg in it. In order to alleviate their troubles they installed a water filter which paid for itself the first year.

Next I was off for Portal. Arriving there I was under the British flag after the engine had passed the customs officer. I went on to Moose Jaw, a divisional point on the Canadian Pacific Railway, and after a night's rest at Moose Jaw I left for Medicine Hat, and on from there to Calgary in the Province of Alberta. This without doubt is the Chicago

SALMON ROCK, NORTH BEND, B. C., CANADIAN PACIFIC.

of the Canadian Northwest. A city of 25,000 inhabitants, beautiful hotels, grand streets, and lots of work with good wages for industrious people. It is situated at the confluence of the Bow and the Elbow rivers about 80 miles east of the Rocky Mountains.

It is tributary to a very rich country. The C. P R. at this point maintains a machine shop for heavy repairs to locomotives. It is also the headquarters of the British Columbia Land & Irrigation Co. of the C. P. R. This great ditch is now irrigating 3,000,000 acres of land along the valley of the Bow River. This country will soon be all taken up. I was told that the land would yield 28 to 30 bushels of wheat to the acre. This is becoming a great dairy country. I found butter to be about 35c. per lb., the same as in Chicago.

I was soon off for Laggan. This is the wonder part of the world. Twenty-five miles this side of Laggan commences the great National Park of Canada. The park is 50 miles long and 40 miles wide. At Banff I saw a fine herd of buffalo, forty odd in number, they being about the only ones in the Dominion of Canada. Leaving Banff I was on my way across the great Rockies of Canada. Arriving at Field, we crossed the great Continental Divide, where a pass was discovered by James Hector in 1858 making it possible to build a railroad through this wonderful country. His remains lie buried at Laggan and a beautiful monument has been erected to perpetuate his memory. On our way westward we followed the Kicking Horse river, brought to light by a vicious animal that kicked Sir James Hector, and it was supposed that he was killed and after recoverying sufficiently to continue his exploration he named the river after the kicking horse.

A few miles west of the Continental Divide we commence our descent. At a point a few miles west we go down a 4 per cent. grade. They will not allow a train of cars to exceed 10 miles an hour on this wonderful piece of track, following the Kicking Horse river which is 3,000 ft. below and great snow covered mountains, 6,000 ft. higher up on the other side. It is almost beyond the power of man to describe this wonderful scene. I was so enchanted that I forgot the day of the month and frequently the day of the week. The sun rose at 3:40 and you could see to read a newspaper at 9:30 at night.

Vancouver, B. C., is a great city; entirely destroyed by fire less than a quarter of century ago, it has been rebuilt and is now inhabited by nearly 65,000 people. This is the end of the Canadian Pacific Railway. The engine was now run on a transfer boat and was off on my trip across Puget Sound to Ladysmith, B. C. I was then transferred to the Esquimalt & Nanimo Railway, which is operated by the C. P. R. I arrived at Nanimo on Aug. 2, the end of my journey. This is the great coal city on the coast of Vancouver Island. They

NORTH BEND, B. C., ON THE CAN. PAC. RY.

mine approximately 5,000 tons of the finest steam coal in the world in one day. Steamships from all parts of the world come here for coal. The coal brings $4.50, f. o. b. on the dock. The population is estimated at about 8,000. They have no "Great White Way" there and

no Singer Building and no Atlantic City, but they are a contented and happy people.

Money is plentiful and they spend it as if they got it easy. Twenty-five cents for a shave and everything accordingly high. After installing the locomotive, I returned by the way of Victoria, B. C., 75 miles from Nanimo. It would be hard for me to describe this great place in this letter. Steamers sail from there to all parts of the world. Seattle is 80 miles away. I took the steamer *Princess Victoria* for Vancouver, a beautiful sail of 85 miles across Puget Sound. Arriving once more in Vancouver, Aug. 9. Traffic was very heavy in both directions. I noticed some of the trains had two dining cars in order to accommodate the people going to the great country for opportunities. I noticed while in transit thousands of idle freight cars and after a careful analysis I found that many of them had long since outlived their usefulness. Many locomotives that I noticed were sadly in need of repairs and many fit for the scrap pile. I think there is a bright future in store for locomotive and car manufacturers. After being 6 days in transit I arrived safely in Philadelphia.

GEORGE H. JACKSON,
Traveling Engineer, Baldwin Loco. Wks.
Philadelphia, Pa.

Theory of the Injector.

Editor:

Contrary to the usual idea of the injector there is nothing mysterious about its action. This being simply a question of volumes and velocities and the correct proportions of the different parts of the injector to obtain the desired results.

Let us briefly consider a No. 10 injector of the simplex type, made by the Nathan Mfg. Co. of New York, which is rated at a maximum discharge of 3,800 gals. of water per hour with a boiler pressure of 200 lbs. Steam at this pressure has a velocity of 2,000 ft. per second, that being the speed at which it would flow into the atmosphere. It also has a volume of 140 at this pressure, that is, a cubic inch of water would fill a space of 140 cubic inches when evaporated into steam at a pressure of 200 lbs., and herein lies the secret of its power. Its great velocity, and reduction in volume when condensed.

When the injector throttle is opened to start the injector, steam from the boiler passes through the combining tube at the high velocity spoken of, viz., 2,000 ft. per second, and this great rush of steam past the opening from the suction pipe exhausts the air from this pipe and the pressure of the atmosphere upon the surface of the water in the tank forces water up into injector where it is seized by the steam and carried with it through the various parts and out at delivery nozzle from which it is discharged at a velocity far below that of the steam from boiler to injector. This reduction in velocity being caused by the heavier weight of the water carried along by the steam.

At the moment the steam comes in contact with the water it is condensed a certain amount, that amount depending upon the temperature of the water in the tank, the colder the water the greater the condension; and in this case let us suppose that the water is cold enough to entirely condense the steam upon the moment of contact. We then have a reduction in volume of 140 and the space that was occupied before by steam is quickly filled with water from the tank which again is carried along with the steam. This action is continuous and at an enormous rate of speed. The amount of water delivered depending partly upon the pressure in the boiler and partly upon the temperature of the feed water, a greater amount being delivered with a high boiler pressure for the reason that there is a corresponding increase in the velocity and a less amount with a rise in temperature of water in the tank, for the reason that there is less condensation of steam with a corresponding reduction of the space to be filled with water from tank, as before described, and from this we can see why it is impossible to use very hot water with an injector.

It has been stated that the water leaves the discharging tube at a velocity far below that of the steam from boiler to injector; and the question arises, How then does it have power to unseat check valve and enter boiler? This is again a question of volume and velocity and weight of water delivered.

If we know the size of the opening through which a stream of water or any liquid is issuing and know the velocity of its flow we can find the volume delivered in a given time by multiplying the cross sectional area of the opening by the velocity; likewise we can find the velocity where the volume is known by dividing the volume by the cross sectional area of the opening. The diameter of the delivery nozzle of a No. 10 simplex type injector is 10½ millimeters or approximately 27-64 of an inch, and the cross sectional area of that diameter would be .1397, and the water delivered according to the catalogue is 3,800 gals. per hour. Reducing this to seconds will give a little over one gallon as the amount delivered in that time; call it one gallon. Now a gallon of water weighs 8 1-3 lbs. and has a volume of 231 cubic inches, and by adding as many cyphers to the volume, viz., 231, as there are figures in the number denoting the cross sectional area, and dividing by the same, we get the velocity in inches per second. Reducing this to feet we get a velocity of 138 ft. per second. Here then we have a weight of 8 lbs. moving towards boiler check at the rate of 138 ft. in one second.

WHITE'S CREEK BRIDGE, B. C., ON THE CANADIAN PACIFIC.

Now if we know the weight of a moving body and the velocity of its movement, we can find the total force it will exert against a stationary body with which it comes in contact. This is done by multiplying the weight by the velocity, and 8 lbs. of water multi-

plied by 138 gives 1,104 lbs. as the force exerted against check to enter boiler against the resistance of the boiler pressure of 200 lbs. per square inch.

Referring to the catalogue it is seen that a No. 10 simplex calls for a delivery pipe with a diameter of 2 in., and the cross sectional area of a pipe of that diameter would be 3.1416 inches. Dividing this total force of 1,104 lbs. by the area acted upon would give the force per square inch; which is 351 lbs. Here we have a pressure of 351 lbs. per square inch on the under side of check against 200 lbs. per square inch in the boiler, and it is not only sufficient to overcome the resistance of the boiler from which the injector

UTO TUNNEL, NIPPON RY., JAPAN.

is taking steam, but would be able to raise the check and enter the boiler of another locomotive that was carrying a pressure of 300 lbs. per square inch. From all this we can deduce the fact that there is nothing mysterious about the action of the injector. It is simply a question of volume and velocity and weight of water delivered in a given length of time.

The Nathan Co. does not give a minimum rating of water delivered in their catalogue, but the minimum amount would be reached by cutting down the water supply to that point where the weight delivered would be just sufficient to overcome boiler pressure upon check valve, and this serves as an object lesson to show why an injector will not work if the tubes become dirty or limed up. In which case the openings would be so restricted that the proper amount of water and consequent weight would not pass through in one second.

We often see the pressure theory advanced in which the action of the steam in an injector is likened to that of the plunger in a pump—forcing the water through a restricted opening with a velocity high enough to unseat check valve against the pressure in the boiler. This theory would perhaps look plausible with a high boiler pressure, but would be exploded when we come down to a pressure of 30 lbs. per square inch, or lower. For instance, the Sellers Company claim that their improved, self-acting injector will work with a pressure down to 15 lbs. per square inch; and in connection with this if we use the usual formula to determine the velocity of the discharge due to a given pressure or head, it would be found to be very low and would call for a large body of water at that velocity in order to get force enough to enter boiler. On the other hand, the supply of water has to be cut down when operating an injector at this low pressure, and for the following reason:

Steam at a pressure of 15 lbs. per square inch still has a high velocity, and a volume greater than it would have at a higher pressure, the velocity being given as 1,400 ft. per second and the volume as 883. In other words, a cubic inch of water evaporated into steam at a pressure of 15 lbs. per square inch would fill a space of 883 cubic inches; likewise if a given amount of steam is condensed it would fill a space only one one hundredth and eigthy-three times as large as it did before condensed. It is thus seen that at the low pressure of 15 lbs. the steam is still moving at a high rate of speed, and that space, left to be filled with water from the tank as before described, is greater than it was with a boiler pressure of 200 lbs. Consequently the supply has to be cut down to that point where it can be handled by the steam, and the proper amount delivered to give the required weight

A LOCOMOTIVE CORNER IN THE PARIS EXPOSITION.

and velocity to overcome boiler pressure upon check valve.

L. C. Allen.

West Stockbridge, Mass.

Leather Tie-Plates and Steel Ties.

Editor:

It seems evident that railways must come to steel ties. But these are fatigued by a certain number of vibrations and break. How can the vibrations of the rails be prevented from being communicated to the ties?

In my stone cutting machine I found that a sheet of belt leather between the hammers and the toolholders prevented any vibration being produced by the blow, and at the end of two seasons' use, 200 lb. hammers giving 300 blows per minute, the leather was as good as ever.

Would not leather between the rails and the ties do the business? The vibration would still be transmitted by the bolts. I think this would be prevented by leather washers between pairs of iron or steel washers.

Chas. L. Porter.

Montclair, N. J.

Round House Foremen, Attention.

Editor:

If you have room will you please put the following note in your next issue? Why not have a Round House Foreman's Association? Let me say to each round house foreman, don't you think we could get up an association

GRADING FOR A ROUND HOUSE.

where we can tell our troubles and hear the troubles of others and the best way to avoid them?

There is the Master Mechanics, the Traveling Engineers and General Foremen's Associations and I think we are as important as the two latter; we are the men who move things and have all the grief.

I would like to see what the men all over the country think of this, through the columns of Railway and Locomotive Engineering.

A. H. Riddle.
Round House Foreman, Colorado-Midland Ry.

Colorado City, Col.

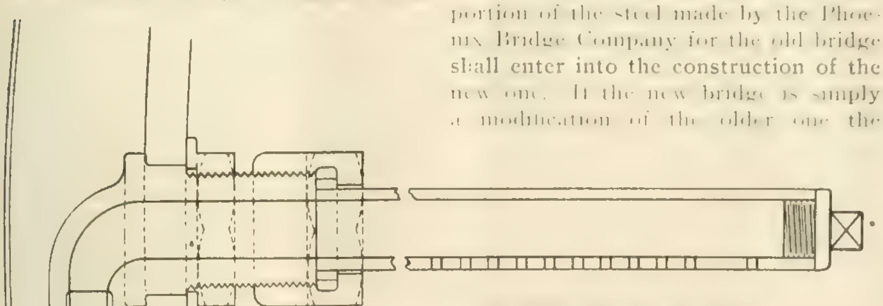
Hurry and Dispatch.

No two things differ more than hurry and dispatch. Hurry is the mark of a weak mind, dispatch of a strong one. A weak man in an office is like a squirrel in a cage, is laboring eternally, but to no purpose; like a turnstile, he is in everybody's way, but stops nobody; he talks a great deal, but says very little; looks into everything, but sees into nothing; has a hundred irons in the fire, but very few of them are hot, and with the few that are he burns his fingers.—[illegible]

Let us do our duty in our office, on the street, and at home, just as faithfully as if we stood in the front rank of some great battle and we knew that victory for mankind depended on our bravery, strength and skill.—*Theodore Parker.*

Smokebox Sprinkler.

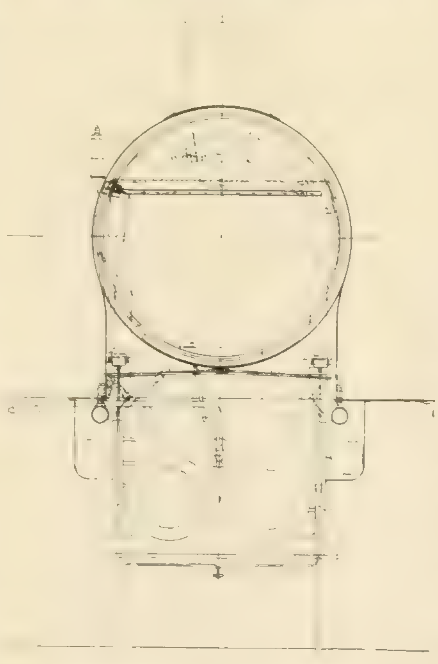
In our September issue on page 504 we gave an illustrated description of one of the De Glehn compounds built by the American Locomotive Company for the Paris-Orleans Railway of France. This



SECTION OF SPRINKLER.

engine is equipped with a smokebox sprinkler which is intended to extinguish lighted cinders, so that when thrown out of the smokestack they will be quite dead.

The device consists of an iron pipe with several small holes in the bottom, which extends across the smokebox 310 millimeters above the center line of the boiler and 130 millimeters from the front end. This pipe is plugged at one end and connected at the other end by means of a union nut and elbow to a small pipe on the outside of the boiler, which runs back underneath the running board, and is connected to a valve tapped into the injector check on the left side of the boiler back head. In this way water from the boiler feed pipe can be turned into the sprinkler pipe in the smokebox to extinguish hot cinders. The device is operated from the cab and if desired a drip of water can be constantly maintained which is capable of killing the sparks in the smokebox, and which is vaporized by the heat of the front end so that the smokebox does not at any time contain any appreciable quantity of water.



SMOKEBOX WITH SPRINKLER.

The Quebec Bridge.

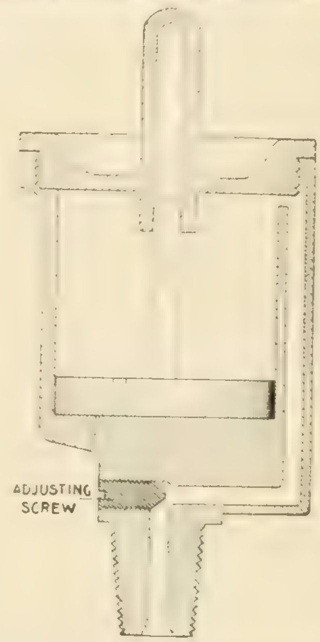
The fallen Quebec bridge is to be rebuilt. The Railway Department of the Dominion Government has entrusted the preparation of new plans to three experts in the profession. They are Mr. H. E. Vautelet of Montreal, Mr. Maurice Fitzmaurice, an eminent Old Country engineer, who was associated with the late Sir Benjamin Baker, the erector of the Forth bridge in Scotland, and Mr. Modjeski, of Chicago, who is recognized as one of the best authorities on bridge building in the United States.

In rebuilding the Quebec bridge, it is believed, an effort will be made to have the structure completed by the time that the Grand Trunk Pacific is ready for operation, that is, in 1911. It is probable that the bridge will be rebuilt where the old one stood, and the three eminent engineers will determine whether the present piers shall be used again, and also whether any portion of the steel made by the Phoenix Bridge Company for the old bridge shall enter into the construction of the new one. If the new bridge is simply a modification of the older one the work can be completed in considerably less time than it would take to work out a completely new design and let contracts.

Loose Pulley Oil Cup.

The loose pulley oil cup probably fills a long felt want, and it is said that it will keep a loose pulley constantly oiled when in operation. The cup consists of three distinct parts: A body, piston or plunger, and an oil-tight cover. All parts are made of a special Swiss brass and are highly polished. The cup is filled with ordinary lubricating oil, after unscrewing the cover, and making sure the plunger is pushed down to the bottom. The cover is then replaced and the cup is ready for use. This cup has a stem with standard pipe threads which screws into the hub of the pulley.

The operation of the cup is simple. The rapid revolving of the pulley causes the piston in the cup to move upward, in obedience to the centrifugal force, thus making the oil flow down through the by-pass to the shaft on which the loose pulley [illegible]. The oil which naturally has a tendency to flow away from the [illegible] of the revolving pulley is thus [illegible] to countermarch right to the [illegible] of action. A small hole is drilled through the bottom of the cup [illegible] below the piston as it [illegible]. The flow of oil is controlled by [illegible] adjusted by a screw driver [illegible] in our illustration, and [illegible] be regulated according to the speed of the pulley. When the pulley stops, oiling automatically ceases. When it starts again, oiling begins. When the cup is attached to exceedingly high-speed loose pulleys, a circular [illegible] is inserted



OIL CUP FOR LOOSE PULLEY.

directly above the piston to prevent the too-rapid rise of the piston.

It is claimed for this cup that it need be filled but once a week. The cup has been placed on trial [illegible] establishments, [illegible] would receive severe treatment, and in every case it has proved satisfactory. It was submitted to one of the large technical colleges [illegible] for examination [illegible] that it was the most simple and scientific thing that had come to that college in many a year. [illegible] ler Co., of Depew, N. Y., have been giving this cup a thorough test in their shops for the past several months.

The cup is made in two sizes by the Lawson Mfg. [illegible] diameter of from [illegible] No. 1. Pulleys [illegible] 13 ins. or over require size No. 2. By the economical oiling of loose pulleys considerable expense [illegible] repairs as the properly oiled pulleys do not become hot and require rebushing.

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Supervision.

"The lack of supervision is the greatest criticism which may be lodged against the railways of the country today." This very striking statement is quoted by a contemporary as the opinion of Mr. W. A. Garett, president of the Seaboard Air Line, and whatever may be the actual state of the case now, there is little doubt that it was true in times past. The accident record has in many instances appeared to justify this view of the case.

The need of supervision is an ever-present necessity even on the best-regulated roads. It cannot for one moment be dispensed with and the work of supervision is never ended. Bernard Shaw, the well-known playwright, dealing with the theme, "Why law is indispensable," says "Imagine taking the field with an army which knew nothing except that the soldier's duty is to defend his country bravely." From our own standpoint we believe the industrial army, such as is found in the rank and file of our railways, is superior in general intelligence to the man behind the gun, but to paraphrase Mr. Shaw's words, Imagine operating a railroad, even with willing and intelligent men who were imbued with a praiseworthy desire to do their best but who lacked any definite knowledge of railroad tactics. It is drill and instruction which makes the soldier's work effective, and it is instruction and supervision which brings the railroad man's performance up to the standard.

So much for the duty of the official to whose lot falls the work of supervision. There is another side to the case and that is if the responsibility for constant and efficient supervision rests upon the official an equally imperative duty rests upon the employee, and that is "amenability to supervision" and to so act that he may help to uphold and strengthen the discipline of the road rather than take a sharp turn and trust to chance or his ability to explain away some questionable act. The force of example is powerful and the older men on a road knowing that the charge of want of supervision has been leveled against American railroad operation, have a duty to perform by example at least, to say nothing of the word of mouth, to the younger men on the road, in helping and guiding them toward a safe and sane line of conduct.

One of the best examples we know of in the matter of amenability to supervision may be found in the excellent record made by the engineers on some of our largest and most crowded roads in the ready response they gave to the so-called surprise check system in signal observance. A noted preacher once said that if a hardened old money-grubber could get into heaven he would find himself woefully out of touch with his surroundings. In like manner on a modern railway properly managed, where are men who welcome and help the work of intelligent supervision, the Chancetaker would find himself to be utterly out of harmony with high standard of efficiency which is brought about and practically maintained by the men themselves.

Some Important Things.

This month our readers have before them some very important topics, discussed by men who have given the subjects they write of a good deal of careful thought. In the correspondence columns, which are open to all ranks of railroad men who have something worth while to say, there is bit of actual and helpful experience on the subject of what we know and don't practice, and the writer very properly remarks in closing, "if you don't know, then learn!"

The Murphy Method of Stereopticon views, illustrating the actual working of railroad rules, is described by Mr. W. B. Blanton, of Sausalito, Col. In his letter to the editor he reviews the "Helping Hand" method devised by the late W. J. Murphy of the C. N. O. & T. P. for the better instruction of the men on his road. The method does credit alike to the head and heart of the late general manager of the Queen & Cresent, for he not only had a kindly feeling for the "boys" who he knew were doing their best, but he felt that it was his duty to provide a way to substantially aid them in the pursuit of knowledge. One might almost think that the straight question asked by the Apostle James came home to him, "and one of you say unto them, depart in peace be ye warmed and filled; notwithstanding ye give them not those things which are needful to the body; what doeth it profit?" Mr. Murphy saw the need for a certain clear method of instruction and he gave it.

The question concerning the derailment of tenders has been taken up by Mr. J. F. Walsh, superintendent of motive power of the Chesapeake & Ohio, and by Mr. T. A. Lawes, mechanical engineer of the Nickel Plate Line. Both these gentlemen have made important contributions to the literature of this subject and their communications will be read with interest. The Traveling Engineers' Association believes this a live topic, for it is to be one of the subjects for report at their convention for next year. Mr. Walsh has given a great deal of attention to the subject, and he says that, whether the track happens to be good or bad, the mechanical department is expected to find a remedy.

In the matter of flue-sheet bracing, Mr. J. S. Pearce, master mechanic of the Norfolk & Western Railway, has offered a possible solution for the leakage of flues trouble, which is worthy of careful attention. His method is based upon a trial on his own road, and the results he states are satisfactory. In this connection it may be interesting to turn back over the leaves of RAILWAY AND LOCOMOTIVE ENGINEERING to November, 1902, page 484.

We gave there the result of an experiment on the L. S. & M. S. to practically answer the question: "Do long tubes vibrate and so become loose at the ends?" The tubes referred then were 19 ft. 6 ins. long and were in some fast passenger engines of the 2-6-2 type. It was found that these long tubes had a certain natural sag between the flue sheets, due to their weight, and that when the engine was worked hard this sag was increased as the tube became hotter than before and so expanded. The tube when cooler became shorter again and did not sag down more than the amount caused by its weight. There was no vibration or shaking of the long tube, although there was some leakage.

Mr. Pierce's experiment and that on the Lake Shore engine are in the right direction, for they increase our knowledge of the actual behavior of flues under exacting service conditions. The results of study and experiment are what we want, and when we

speak of study we think of those men who are not in a position to order or conduct experiments, but who intelligently apply their reasoning powers to the solution of any problem and who can interpret phenomena and who can give the results of their knowledge and experience.

Minor Repairs to Cars.

Some time ago the Car Foremen's Association of Chicago discussed what we have called minor repairs to cars. The discussion turned upon the loss of bolts, nuts, cotters, etc., from freight cars. The fact that these defects are spoken of as minor does not imply that they are not important. Proper repairs in this respect are very important.

There is one minor defect which appears more frequently than all the others and that is the loss of nuts, loss of axlebox covers perhaps comes next, but a very serious difficulty which is always present in making the necessary repairs is the want of time. Railways have the material and the men, often they have men specially detailed to do this work, but the operating department does not give the men time to do the work. A nut off a bolt is not considered of sufficient importance to delay a car and the car goes on without it, and in practical everyday life there really never comes a time when the car gets its quota of nuts renewed until it has to stand still for heavier repairs.

One of the speakers at the meeting made a very strong point when he said, "We do as much as we can. We have men go through the yards who carry a string of nuts, cotters, and such things; and tools to apply the nuts, and they do what they can without endangering their lives." This sort of work is usually done where cars are not definitely held for the repairs and when a car is liable to be moved at any moment.

The importance of the so-called minor repairs is evidenced by the remarks of another speaker, who said: "I think the operating department should concede this much to us, and give us an opportunity to do this work. There are many times that we find a coupler slightly defective, the carrier iron coming down, or missing truck bolts. If we could apply them then and there it would many times save serious trouble in the way of additional defects.

One of the remedies proposed for the loss of nuts was the use of nutlocks and cotters, but they take time to apply just as the nuts do and there is no provision for the use of cotters on every bolt. The loss of axlebox covers is a serious thing. The loss of the cover permits sand and grit to get into the box and lie upon the exposed portion of the packing, and when the packing is shoved in by the oiler and new packing applied, he has really pushed in the sand and grit to a place where it will do most harm.

There is nothing more humorously illogical, if one may be permitted to say so, than to see a car of important freight supplied with an excellent and possibly expensive dust guard at the back of the box and no box cover on in front. Inventors have been quick to recognize that condition, and there are now on the market box covers that will not come off and these are not held by bolt and nut. In this way the security of the cover is guaranteed and there is in each case one bolt less to look after. With the same idea in view the boltless truck has been designed. The fact that these minor repairs are difficult to make and that when made they may require to be looked after again in a sort time makes the performance, what theatre managers would call, a continuous one. The reduction of parts which can jar off and be lost is one of the features that modern designers are now constantly keeping in view when getting out new equipment.

Compound Locomotives.

It is to be observed in many of the larger locomotive repair shops that there is a kind of reactionary movement going on against the continued use of the compound locomotive. The same change is observed in the repair shops of Europe as in America, and is particularly marked in the chief railways in England. In spite of this tendency it is an undoubted fact that the compound engine has advantages that cannot be gainsaid. That these advantages are not altogether theoretical is evidenced by the general adoption of the compound principle for many engines in the marine service. The facts are that what may be found practicable and advantageous in one kind of service, may not be suitable in a service embracing totally different conditions. Stationary engines admit of a massiveness of bearings and a general structural solidity not possible in the locomotive, and it was readily observed that while the compound engine as used in locomotives generally gave evidence of excellent service for the first few months, the deterioration was so rapid that it is no mere figure of speech to state that after a period of hard service a compound locomotive began to act like a ship that had sails set to move both ways at once.

The tendency of the intercepting valves and reducing valves with their expansible rings and three-way cock attachments, and gradually widening dash pots and ground joint seats to get out of order, was not to be wondered at, and to the average round-house foreman's life was too short and the available forces too limited to maintain these complex adjuncts of the compound locomotive in perfect condition. Labor, particularly skilled labor, has its limitations and so a general feeling of weariness of the flesh has overcome the railway men in dealing with the compound locomotive.

The return to first principles is nothing new in mechanism or in ethics. It is the natural evolution that comes to the seeker after the ideal. Perfection eludes, and ever will elude the inquiring mind. In mechanism, as in art, it is the simple that is the most enduring. In the use of the compound locomotive lessons have been learned that will be of value to future constructors, and the constant improvement of the locomotive will go on from trial to triumph and from the experimental to the practical.

Crown Sheets.

The rarity of locomotive boiler explosions is owing largely to the constant attention given by the engineer and firemen to the boiler, to which is superadded the work of the boilermakers and boilerwashers. Boiler explosions in the twentieth century occur largely in remote sawmills and quarries and other industrial establishments where the lack of skill is pitiful, and the lack of common sense almost criminal. A short time ago we heard of a farmer who, in his anxiety to get a little more power out of a wornout boiler, tied the kitchen poker to the safety-valve lever. The increase of power brought down the crown sheet and threw the old boiler in the air.

Locomotive engineers have too much respect for old age to attempt an experiment of this kind, and the rule among skilled engineers is to lower the pressure as the age of the boiler increases. Much progress has also been made in boiler construction, and while a variety of opinions exist as to the best form of locomotive fireboxes it is becoming more and more generally conceded that radial stayed crown sheets are not only the simplest, but best form of firebox construction, the cylindrical shell enclosing the flues being universally conceded to be the best form in that particular portion of the boiler.

The use of crown bars has several important drawbacks. The flattening of the crown sheet forms at once a kind of receptacle for the accumulation of mud and the presence of the crown bars renders the perfect cleaning of the crown sheet almost impossible. The crown bars take up much valuable water space, and it is generally found that crown sheet troubles occur more frequently when fireboxes are constructed with flat crown sheets. On the other hand, when radial stays are used the crowned sheet may be arched and the stays placed at right angles. Mud cannot readily accumulate and can be easily removed, and the entire in-

ner surface of the firebox can be easily inspected.

The important improvements in the structure and quality of the staybolts contributes also in no small degree to the comparatively high degree of safety of the boiler of the modern locomotive, and it is gratifying to note that the adoption of systematic inspections and tests all tend in the direction of making locomotive boiler explosions of less frequent occurrence.

Mud Remover on Locomotive.

On the Austrian State Railways some experiments in water purification have been made in rather a novel way, yet the apparatus used is quite simple. Deposits are formed on the inside of the boiler immediately below the top check. Water entering the boiler loses its velocity as it emerges from the check valve and the higher temperature of steam and water inside precipitate a large quantity of the solid matter contained in the water.

The arrangement used on the Austrian railways is to provide a long flat receptacle inside the boiler, into which the check valve opens. This receptacle is in communication with the interior of the boiler through several holes in the top, and it lies close along the boiler shell inside, clear of the flues. At the bottom of this receptacle there is a blow-off cock which carries off the mud which collects in the receptacle. This blow-off cock is opened and closed from the outside and discharges below the engine.

These receptacles are blown out about every 100 miles on the trip, the injector being worked at the time so as to augment the pressure in the mud chamber and forceably drive it out. Very satisfactory results are said to have been achieved by this apparatus, which practically compels the mud to form in a given place. The deposits are reduced to the consistency of sand, which are readily removed, instead of forming in hard masses which tightly adhere to the boiler.

The receptacle is cast iron, made in two pices bolted together. Comparatively little space is occupied and the frequent use of the blow-off cock always keeps it clean.

Railroad Club Proceedings.

The fall season is upon us, and the many railroad clubs are beginning to take up the serious work ahead of them. These gatherings of railway and supply men are somewhat informal in character and permit of social intercourse which is not only pleasing but useful in bringing men together.

The New York Railroad Club held its first meeting this season a short time ago, and a large and representative audience listened to the paper on "Better Service at Reduced Cost," a brief synopsis of which we give in another column under the heading "Supervision and Standardization," for this was the keynote of the subject. The advanced copy of the New York Club proceedings contained an innovation which is both convenient and useful. The paper was printed in the usual way, but there were a series of marginal headings or paragraph captions which made it easy for those discussing the paper to indicate the parts of the paper to which they referred and their hearers had no difficulty in finding the place. Mr. Harry Vought, the secretary of the club, is to be congratulated on this handy little improvement.

Another point which is of the greatest convenience is the printing of the title of the paper on the front of the cover of the proceedings. This has been done by the New York Railroad Club for years, and, indeed, it may be said to be the general rule, though there are exceptions. When it is done, it is of the greatest convenience when one comes to turn back through the year's file for some paper of particular or unusual interest.

Prospects.

The return of prosperity is bound up more or less intimately with the harvest. The political situation in any country is important, but it is not the only factor. The state of the crops has a great deal to do with what we call prosperity, and in this direction the outlook is good.

The crops in the United States are from all appearances bountiful and those in Canada will be all that can be wished if reports are true. A recent press from Winnipeg says:

"Taking the average of the estimates of the wheat crop made by those who have given the matter sufficient study and attention to enable them to speak with some authority, the figure 110,000,000 is arrived at, and may be safely taken as a fair approximate estimate of the total wheat yield of the Canadian Northwest.

"The estimate of the oat crop, of 91,000,000 bushels, and of barley of 33,000,000 bushels, added to that of the wheat, will give a good idea of the large volume of traffic which the railways are confronted with, and which will tax their capacity and keep them all busy for the next twelve months.

"An important feature in connection with this season's harvest is that the crops are fairly uniform, no district particularly suffering to any extent, and, consequently, money will be pretty generally distributed over the whole country."

The C. P. R. have their main line between Winnipeg and Fort William double-tracked all but about 25 miles.

Book Notices

RAILWAY TRACK AND TRACK WORK. By E. E. Russell Tratman, A.M. Third Edition. 520 pages cloth 6 by 9 inches. 232 illustrations and numerous tables. Published by the Engineering News Co., New York. Price, $3.50.

Mr. Tratman has long been known as an eminent authority on railway track and track work. The favor with which the first edition of his book was received showed that there was a strong demand for such a work, and the appearance of a new edition will be gratifying to all interested in the subject, and especially to young engineers intending to enter this important department of railway service. Mr. Tratman has kept abreast of the subject and those who have copies of the earlier editions should not hesitate to secure a copy of the new work, embracing, as it does, a full description of all of the important changes both in materials and methods since the appearance of the edition twelve years ago. The author's style is at once descriptive and critical and shows how thoroughly he has mastered the subject, while the higher faculty of imparting information to others is shown in his lucidly interesting pages. It is the best work of its kind.

The first annual report of the Public Service Commission of the State of New York has just been issued. It has the usual ponderous appearance of State reports, making a heavy volume of nearly 800 pages printed in small type. Perhaps the most interesting part of the book is that devoted to the inspection of steam railroads, from which it would appear that the railroads of the State are in a condition of repair that leaves little to be desired. It is gratifying to note that the fencing in of railway tracks is being rapidly proceeded with, as also is the reconstruction of many bridges. The accompanying railway maps are very beautifully executed and add much to the value of the book.

At the Chicago meeting of the General Foremen's Association a paper was read on the question: "Why Do Staybolts Break More Frequently on the Left Side?" It was Topic No. 6 and was printed on page 307 of our July issue. This month we give some remarks made in the discussion which followed on the reading of the paper. We would like to hear from some of the boilermakers who are directly concerned in locomotive repair and maintenance on this subject. The left-hand pound in the driving-box of a locomotive, when it exists, has a definite reason. Do staybolts break more readily on one side of a boiler than another, and if they do, why is it?

OBSERVATIONS ON BRITISH RAILWAY MATTERS

By Angus Sinclair

Reminiscent

After having resided in America 13 years, in 1885 I went on a visit to Europe, holding high expectations of the great change I would be able to describe as having happened during my absence. I landed at Southampton, which is in the south of England. I had been familiar with the railway rolling stock of both England and Scotland before I went to America and I landed on my return keenly impatient to note the marks of progress imprinted upon the railways during my absence and it became a matter of disappointment to find that everything remained very much in the same condition as it was when I went away. It was my privilege at the time to travel nearly the entire length of the Island of Great Britain, which includes England and Scotland, and the conclusion reached was that the railway locomotives and carriages displayed no sign of progress.

In looking over a British railway paper of recent date I notice some complimentary remarks about locomotives that were put into service on an English railway in 1844 being still in use. That implies a sense of veneration for old things that moves people of the Old World to build museums for the preservation of antiquities and to look with admiration upon the pioneer machines that took part in the introduction of new industries. The practical result of this sentiment works to keep our British friends slow in making changes and to cling with peculiar tenacity to the things that have proved useful.

During the thirteen years that I had been in the United States, I had seen so many reputed improvements made upon the railroad machinery and had become so much inspired by the phrase "progress" that the doings of my boyhood world looked paralyzed when the people were only making haste slowly. Soon after reaching the end of my journey I "foregathered," as the Scots say, with my very old friend and associate, John F. McIntosh, now locomotive superintendent of the Caledonian Railway, and found him inclined to boast about the great improvement effected since we had parted some fifteen years before. The Hawthorn type of engine, a favorite in my time, with two pairs of coupled drivers in front and a single pair of carrying wheels under the foot-plate, had gone or was consigned to branch lines; the engine with a single pair of driving wheels was becoming less popular than it had been when I was pulling the throttle, the form with two pairs of coupled wheels behind and a single pair of small leading wheels in front was becoming the favorite passenger engine and was rapidly finding favor and the four-wheel truck (called bogie) was to be seen on some lines. McIntosh reminded me of the days when the bare boiler head had been our only shelter from the fierce Scottish weather and pointed with pride to the protecting weather boards that almost deserved the name of cab.

Pointing to a substantial-looking six-coupled "Goods" engine, my friend proceeded to dilate upon the imbecility of the scrap heaps made to do duty as goods (freight) engines a decade or two earlier. In passing I may remark that the six-coupled engine without truck, almost universally employed hauling freight trains in Europe, has been wonderfully popular and successful. On reflection and more detailed investigation I found that the period which I had considered barren or short of growth was merely a backward springtime that brought forth the crops of our modern practice.

Since that first visit, I have returned about every second year, every time paying close attention to the progress made during the interval, and it has been a series of interesting experiences.

LOCOMOTIVE DEVELOPMENT IN EUROPE.

In one of his interesting treaties on the development of the locomotive, Professor Goss devotes considerable attention to what he calls "The Passing of the Eight-Wheel Locomotive." That is the engine so long and favorably known par excellence as the American Locomotive. From what the learned Professor said, most of us were convinced that the 4-4-0 locomotive had passed the day of its usefulness and that other forms were rapidly pushing it out of service. That was true of America, but not of other countries. About the time Professor Goss made the prediction referred to the 4-4-0 type seemed to be solidly establishing itself into favor in Europe as the favorite passenger engine. With us the American engine jumped into favor perfectly formed in 1836, when Campbell added a pair of driving wheels to the old 4-2-0 of Jervis that had suffered so grievously from deficiency of adhesion.

Our British friends reached the 4-4-0 form through a more tedious process of development. As my memory and observation cover all the forms tried since the time of the Stephensons, with all particulars of this important evolution standing before me like an open book, I may be permitted to outline briefly the lines of labor that established the favorite engines. The tendency to preserve old engines as monuments or as curiosities gives excellent data for a graphic history.

The first British locomotive to obtain popular favor was one carried on four wheels like the Pennsylvania Railroad "John Bull" and the New York Central "De Witt Clinton." The shortcomings of that engine soon made themselves manifest. One set of British locomotive superintendents or builders added a pair of carrying wheels under the foot plate to lengthen the wheel base to make a steadier riding engine, while others tried to effect the same improvement by putting a pair of carrying wheels in front to perform the functions of the Jervis truck. A favorite form of passenger engine had a single pair of large driving wheels beneath the middle of the boiler and a single pair of carrying wheels in front and rear.

The practice of Continental railways did not differ materially from that of Britain, which gave them forms of motive power and gauge of track even down to the odd half inch.

On my various visits to my native land I was always watching the line of progress and noted year by year a strong tendency to follow American practice except in some unimportant details, if slab frames and inside cylinders may be considered little different from bar frames, and outside cylinders. Gradually the fast running engines with the coupled driving wheels in front were abandoned, gradually the single pair of carrying wheels under the smoke box were replaced by a four-wheel truck and to-day that form of engine is found pulling nearly all passenger trains in the British Isles. The Atlantic type is coming gradually into favor and is known by the name given it by Baldwins. There are a great many oddities among the passenger train locomotives seen on Continental Europe, but the 4-4-0 is the most common form in use. The motive power officials belonging to the Continent seem to have been ahead of their British rivals in perceiving the necessity for powerful freight engines and those seen in Austria, Switzerland and some other parts rival the heaviest American freight power.

One finds curious diversity in some important features of motive power in different countries. The compound locomotive first found favor in France and that type of engine continues to be a favorite on many Continental railways, but on others it has no standing whatever. In the British Isles there were a great many compounds introduced by the late F. W. Webb, of the London and Northwestern, and his imitators, but their name is Ichabod to-day—that is no more. The anecdote is told of a school class being under examination when the teacher asked, "What man's name in the Bible means "no more"? The question was too much for the urchins

at first; then one bright little chap held up his hand and exclaimed "Dennis"! and Dennis it has been since that day.

STANDING OF COMPOUNDS

When I was visiting Cluny Castle in Scotland some fifteen years ago I met a director of the London and Northwestern Railway, who had very positive views concerning the compound locomotives with which Mr. Webb was stocking the railway. He said to me that he told Mr. Webb that the Board of Directors would compel him to change all the engines back to simple. Mr. Webb seemed to be sufficiently influential to defy that threat during his life time, but he had no sooner gone than his successors began making the change and the work is going on so steadily that it promises to be completed within a very few years.

Some other British railways are using compound locomotives to a limited extent. The sentiment concerning the merits of such engines is here similar to what I have noted at some Railway Master Mechanics' Association Conventions. Members would express their opinions frankly and freely about compounds in private conversation, but when the subject would come up for public discussion the same members would be as dumb as oysters.

The lines favored for increasing the efficiency of the locomotive are similar to those in favor in America. The promoting of careful firing has produced excellent results, for very little smoke is to be seen from engines burning very rich bituminous coal. The only smoke preventer in use is a simple method of admitting air above the fire, a low set fire-door and brick arch. In starting from stations with heavy trains most locomotives produce considerable smoke, but the local authorities pay no attention to temporary nuisances of that character. But then there is no super-zealous official trying to make for himself petty political capital by abusing railroads.

LINES OF IMPROVEMENT.

The mechanical officials of some few British railway companies are standing with reluctant feet resisting attempts to make them believe that steam superheaters are money-saving appliances; others have ventured over the brink and are accumulating experience. Several forms of steam superheaters are proclaiming themselves willing, but the caution, not to say obstinacy, of John Bull prevents any rush for the latest steam saver. Some parties are whispering feed-water heaters above their breath and offering to effect great saving by utilizing heat that is generally wasted. There is nothing new under the sun, or in the smoke box when it takes the form of a feed-water heater. When its apostles alight upon our shores, I shall pursue the subject.

One Yankee invention is becoming popular in Europe, viz.: asbestos covering for locomotive boilers. Only a few years ago wood lagging was considered satisfactory, but one day a fluent talker from the United States began calling upon locomotive superintendents armed with specimens of asbestos lagging and he conquered ingrained prejudices.

British railways constitute a form of property that pays less to the investors than any other kind that has a legitimate foundation. The dividends have been steadily decreasing and the indications are that some of the lines will soon cease giving any returns to the shareholders. This condition of affairs prevails on roads doing an excellent business. It is a case of the expenditures being too close to the income. In studying the details of British railway operating, it strikes me that the weak business point is senseless competition which manifests itself in numerous fast trains that are run without carrying paying loads.

Supervision and Standardization.

Among the points brought out by Mr. Raffe Emerson of the Atchison, Topeka & Santa Fé in a paper recently read before the New York Railroad Club was the economy of standardizing engine equipment; and by that is meant the small tools used by the engineer and fireman, and the easy recognition of what belongs to engines as distinguished from similar articles used in the shop and elsewhere on the road. Among other things he said:

These locomotive equipments consist of all the movable tools and furniture carried on engines such as wrenches, hammers, chisels, shovels, oil-cans, torches, tool-boxes, cab-curtains, cushions, arm-rests; wrecking tools, such as frogs, jacks and chains; shunting poles, bell-cord, headlight chimneys, and such small supplies as soap, headlight and signal oil, headlight carbons, waste, etc. Most of these articles are included in Account number 85 (for road engines, the corresponding account for yard engines being number 76) of the Interstate Commerce Commission Prescribed Classification of Operating Expenses, in force July 1st, 1907, and by supplement of July 1st, 1908.

As an example, take the simple cold chisel. The style used on the engines of the Santa Fé is made out of hexagon steel, and those for the shop are octagon in section. The name of the road is plainly stamped on each. The result of this is that a shopman found with a hexagon chisel or a locomotive engineer using one of octagon section may fairly be described as having been "caught with the goods." The locomotive hammer has also distinctive characteristics. It has a short handle so that it can be used in tight places. It weighs 2 pounds and is thus about the weight of a boilermakers' hammer. It has a cross wedge-shaped pein, which not only differentiates it from the ball-peined shop hammer, but the wedge pein is as useful on an engine for lifting axlebox lids as the pein of a car-inspectors' hammer is useful in car yards. The engine broom is short and stiff, and is purposely made so that misappropriation is easily detected.

Not only should all articles of the equipment be properly selected for the best service and standardized, but the tool-boxes, racks and other receptacles are designed for accommodating each article in its proper place, according to the convenience of the enginemen, and also with the purpose of locking articles up securely yet simply, and of permitting ready and rapid inspection.

Of necessity the process of standardization must be a gradual process. It must be a gradual replacing article by article, engine by engine, wherever changes are necessary to secure the better service incident to standard practice. In many cases the new standard articles need not replace the older designs that are in actual service until the latter are practically worn out or are lost. In other cases, the articles in use may be made standard without change in design. On most roads such a change would probably pay for itself in two years; in actual practice, where the process of standardization was a gradual one, the cost of the change would never be felt.

From standardization we have drifted into supervision, which must be complete. In the first place, there should be an equipment inspector, or engine supplyman, or tool-checker at every large engine house and repair shop. This man should have the entire handling of all supplies that are put on engines or taken off them, both turning at roundhouses, and passing through shops. He should check over the equipments each time the engine comes in, and again before it goes out. He should fill shortages. He should see that damaged articles, as can be, are repaired. He should be a man of some experience about engine houses and engines, perhaps an old engineer whose eyesight may bar him from service. His rate may amount to as much as 40 cents an hour at a large engine house or in the Far West, It may be as little as 15 cents an hour—but a rather higher rate will usually get a man who will save the difference many times over. If additional men are needed, as at a busy terminal, and also for night duty, they should report to the head supplyman who alone should be responsible.

We have now touched upon the principal considerations involved in a closer supervision of locomotive tool and supply equipments. It is almost needless to point out to railroad men that what is everybody's business—generally—becomes no one's business—specifically, and that, to secure certain and complete results, the carrying out of the plan should be entrusted to a competent man under the direction of the S. M. P.

Applied Science Department

Elements of Physical Science.

Second Series.

I. Steam.

In beginning a series of articles on the production and use of steam it may be stated that our aim is to present in an elementary way a study of the methods necessary in the generation of steam and its application so that the highest degree of efficiency may be obtained from the use of steam as a motive power. It is hardly possible in the space at our disposal to point out the endless variety of forms of boilers and other structures used in the production of steam, and we shall confine ourselves more properly to what may be regarded as the essential elementary facts regarding steam which should be known by steam engine men generally and railroad men particularly.

It will be readily noted that the effect of heat on water enclosed in a vessel is manifested by the water becoming warm, and that the degree of heat to which the water may attain by the heating process does not in any way affect its weight. Should the application of heat be continued until the water has changed into steam, the weight of the steam will still continue to exactly correspond with the weight of the water and on being allowed to cool the steam will return to the original form and bulk of water. This, of course, is based on the assumption that the vessel is perfectly tight and none of the steam has been allowed to escape. It will thus be seen that heat being as Tyndall has shown, simply a mode of motion, is without weight and the application of heat does not affect the weight of any body. Heat, however, has the quality of affecting the cohesion of bodies. The force of attraction which holds the particles of bodies together is disturbed by heat.

All bodies are at times in a state of minute vibration and the greater the degree of heat that is applied to a body the more violent becomes the agitation or vibration of its particles. If a degree of heat is reached which entirely overcomes the cohesion of the particles of the body which is being heated, the particles will fly off in all directions and assuming a gaseous form become invisible. It must be remembered that they are not lost, as all matter is indestructible. The separated particles may not be brought together again in the same form, but they have lost nothing and exist somewhere.

In regard to the heating of water in an enclosed vessel, when the heat has become so great that the particles of water begin to fly off in a gaseous form, it is this rushing into space of the loosened particles or maddened molecules as they may be called that produces what is known as steam pressure. The greater the degree of heat the greater will be the degree of force exerted by the escaping gases. This is what is occurring when a boiler is being heated and when a pressure of steam has been generated from the water enclosed in the boiler, and the inventive genius of intelligent humanity has succeeded, after centuries of experiment, in successfully harnessing this mysterious and mighty force. Heat is therefore a form of energy, and transfused through water can be made to perform mechanical work. The ratio of the degree of heat and the amount of work possible of accomplishment can be readily demonstrated as the relation between heat and work in an unvarying constant.

In recording the degrees of heat the thermometer is at once a simple and perfect instrument. The ready expansibility of mercury when heated renders that metal well adapted to indicate on a graduated scale the degrees of heat. As is well known a supply of mercury is held in a bulb to which a tube is attached. The quantity of mercury can be readily adjusted so that it will reach a certain height in the tube at the point when water freezes. On the Fahrenheit thermometer this point is marked 32 degrees. If the mercury bulb is placed in boiling water the column of mercury in the tube will rise rapidly and become stationary at another point. This is marked 212 degrees. A graduated scale is arranged between these points and may also be extended upwards or downwards.

It is a singular fact in nature that vastly varying amounts of heat are necessary in raising the temperature of bodies. In this regard water is generally taken as the basis in estimating the various amounts of heat required to raise the temperature of other bodies. This ratio is called the specific heat of bodies, and in comparison with a few of the most common metals, we might place the amount of heat necessary to raise the heat of a body of water one degree as 100. A piece of steel of the same weight as the water could be raised in temperature the same amount by less than 12 units of heat. Wrought iron should be equally heated by 11, and copper by 10, while lead would only require 3. It will thus be seen that it takes 33 times more heat to raise the heat of water one degree than it would take an equal weight of lead.

This phenomenon is of inestimable value in the conservation of energy derived from the use of steam as a motive power. It will be readily understood that the amount of energy to be derived from steam is an exact ratio to the quantity of heat in creating the energy, and if water could be as easily heated as lead is, the capacity of the modern locomotive boiler would require to be more than thirty times larger than it is at present. A machine of this proportion could not be made to move itself, and even a stationary steam engine so constructed would be almost useless.

Locomotive Whistles.

By Sidney C. Carpenter.

The sound produced by a whistle depends upon three things: its length, form, and to some extent on the relation between the diameter and length. Sound itself consists of a series of waves, or vibrations, spreading out in all directions from a vibrating body as a center, and the pitch of the sound depends upon the wave length from one point to the corresponding point in the next wave. The longer the wave length the lower the tone. When the steam strikes the edge of the lip it sets the thin metal into rapid vibration which, in turn, causes the air in the bell to vibrate. The wave length of the sound produced and, therefore, the pitch, depends on the length of the air column in the bell.

The following experiment illustrates the effect of the length and form of the bell. A paper tray covered with a thin layer of sand is lowered into the end of an open organ pipe which has one side made of glass. When the pipe is sounded and the tray is at the top the sand dances violently. As the tray is lowered the motion decreases till it practically ceases at the center of the pipe; if the tray is lowered still further the motion increases till the sand is again dancing at the bottom. If a cover is placed on the pipe, with a small hole through it for the string, the sand still dances at the bottom of the pipe, but is quiet at the top. The point of no vibration is called a node and the distance

from the node to the point of greatest vibration is one quarter of the wave length. The air column in the first case was half a wave length long while in the second case, which corresponds in form to the bell of a whistle, it was only one quarter of a wave length. The closed bell of a whistle gives a wave twice as long as it would if it were open at the top and the note is lower. In the same way a longer bell gives a lower note.

The chime whistle depends on the foregoing principle. A whistle with a single bell gives a single note, but if the bell is divided into several compartments of different lengths a combination of several notes is the result. In a somewhat different way the principle is applied to steamboat whistles, which sometimes have a piston fitted in the bell. By raising and lowering the piston the length of the air column and the tone of the whistle can be changed at will.

There are three general types of valves used to admit steam to a whistle: the upright, side and automatic. The upright valve is placed vertically in the pipe at the base of the whistle and is operated by an arm of the bell crank. The second type is placed horizontally across the pipe and the valve terminates in a rod which bears against the lower arm of the whistle lever. These two types are used principally for small whistles and low pressures. As the steam pressure or the size of the valve is made greater, the pressure against the valve rapidly increases, as is graphically shown in the diagram, which gives the pressure on valves from ¼ inch to 2 ins. diameter for several steam pressures. For large whistles and high pressures, some means must be used to enable the valve to operate easily and rapidly and the automatic valve has been adopted for this purpose.

This type is somewhat similar to the second type described, but the valve ends in a large piston working in a chamber to which steam is admitted by a small independent valve. When the independent valve is opened steam enters behind the large piston, which, being larger than the valve, promptly forces it open and admits steam to the whistle. When the small valve is closed the steam behind the piston escapes through an opening provided for the purpose and boiler pressure on the valve forces it to its seat. In another type of automatic valve there are openings in the piston so that the pressure on both sides is equal. The small operating valve opens directly into the piston chamber and exhausts the pressure on one side of the piston to the atmosphere and the pressure on the other side promptly pulls the valve open. It is said that a piece of light twine will operate this whistle with 200 lbs. boiler pressure.

For the upright valve the whistle lever is a bell crank, the short arm of which operates the valve. For the side valves a straight lever is used. By straight we mean that the straight lines from the center of the pivot to the point where it operates the valve and to the hole where the operating rod is attached are practically in the same direction. These distances determine the leverage, which is not affected by the actual shape of the metal. The power required to operate the cab lever depends upon the proportions of the connecting parts. Suppose the long arm of the whistle lever is 8 times as long as the short arm and there is a total pressure on the valve of 800 lbs. Then it will require a pull of 100 lbs. on the end of the whistle lever to operate the valve. If the operating lever in the cab has a leverage of four to one it will require a pull of 25 lbs. on the operating lever to blow the whistle. With the automatic valve the small one is the only one operated by the engineer and it is so small as to require very little force to move.

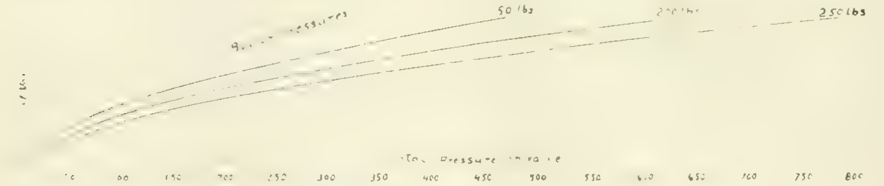


DIAGRAM OF PRESSURES ON WHISTLE VALVES

If you know the size of valve in the whistle on your engine and can determine the leverage between the valve and cab operating lever, it might be an interesting experiment to calculate the force required to blow the whistle and then use a spring balance to pull the lever with and note the actual force.

A whistle, like any other mechanism, is subject to defects and, as it is not of much use if the valve is out of order, the operating parts must be carefully designed to do their work with the least attention. As far as possible they should be so designed that any derangement will not tend to operate the whistle. In the first type of automatic valve described the small exhaust port from the piston chamber takes care of any leakage past the operating valve and when the whistle is blowing any steam which escapes past the piston or stem will reach the air through small holes in the casting without raising the pressure sufficiently to stop the whistle. In its exposed position a whistle is subject to extremes of temperature and allowance must be made for expansion or contraction. If the piston binds for any reason the whistle either will not blow or will not stop blowing. All wearing parts should be capable of easy removal for inspection. This applies to the valve seat as well as to the valve, as they are both subject to the cutting action of the steam.

Celebrated Engineers.

XII. Robert Fulton.

In the early settlements of America, however difficult the problems were that confronted the pioneers, the encouragement to mechanical engineering was exteremely limited. The Mother Country was supposed to furnish the machinery and implements necessary in the struggle with the grosser elements of the earth. After the Revolution a new order of things set in and the nineteenth century has seen American inventions take their place among the highest and best.

One of the earliest and most distinguished of American engineers was Robert Fulton, born at Little Britain, Pennsylvania, in 1765. He began at an early age as a portrait and landscape painter. In his twenty-second year he visited England and, in addition to pursuing his studies as a painter, he devoted considerable attention to mechanical engineering. He obtained several patents in Britain, one in relation to an improvement in canal locks, and others for flax-spinning and rope-twisting machines. At the age of thirty-two he removed to France and remained for seven years in the house of Mr. Barlow, the American minister at the court of France. He continued his mechanical investigations and produced among other inventions the first moving panorama ever exhibited in Paris. He also made some important experiments on submarine explosives. In this he was encouraged by Napoleon, and through his influence Fulton was enabled to perfect a submarine boat, the first of its kind to remain under water for several hours.

His fame as an engineer was now world-wide, but neither the French nor British government gave him such encouragement as his marked inventions deserved, and he returned to America. In 1810 Congress appropriated $5,000 to aid him in further experiments, and he was latterly appointed a commissioner in connection with the scheme of connecting the Hudson River with the Great Lakes by canal. While in France he had experimented with steam navigation, and had had the oppor-

made up, and on account of the different tunity of seeing the results of other eminent engineers' work in the same direction. He was undoubtedly the best-equipped engineer of his time to bring the subject of steam navigation to a successful issue. On his return to America he began the construction of a steamboat named the "Clermont," which was destined to successfully establish the propulsion of vessels by steam. In this project he was warmly aided by Chancellor Livingstone and other influential Americans.

The new vessel when completed was 133 feet long, 160 tons displacement, and was by far the largest and most substantially constructed steam vessel hitherto experimented with. It was eminently successful from the beginning and sailed regularly between New York and Albany for many years. In the successful introduction of steam navigation there is much resemblance between the work of Fulton and that of Stephenson, who at a later period established the locomotive. Both availed themselves of the work of others. Neither introduced any new feature in steam engineering. Both used Watt's engine exactly as perfected by the Scottish inventor. The others who had worked in the same field, however, had fallen short of success, chiefly from the lack of support. The Hudson River formed an admirable channel for the operation of Fulton's steamer and its appearance marked an epoch in the history of navigation.

Among the last works of Robert Fulton was the designing of a floating battery, the forerunner of the modern battleship. His plans were approved by Congress and he was appointed sole engineer, but before the completion of the coast defence ship he died at the early age of fifty years. He was a fine gentleman, an excellent scholar, an accomplished engineer, universally respected and greatly mourned by all who had the honor of his acquaintance.

Generous.

"Good morning!" said the claim agent cheerfully to the patient with a broken leg and head in bandages. "I have good news for you. Yes, sir. The company feels sorry for you. It is willing to forgive and forget. Soulless? Why, man, it's all soul."

"Ready to pay about five thousand?"

"N-no, not exactly that. But I am authorized to sign its agreement not to prosecute you for letting yourself get thrown on the right-of-way and blocking rush hour traffic." —*Philadelphia Ledger.*

The Railway Signal Association will hold their twelfth annual convention at the New Willard Hotel, Washington, D. C., on October 13, 14 and 15. A number of interesting papers have been prepared.

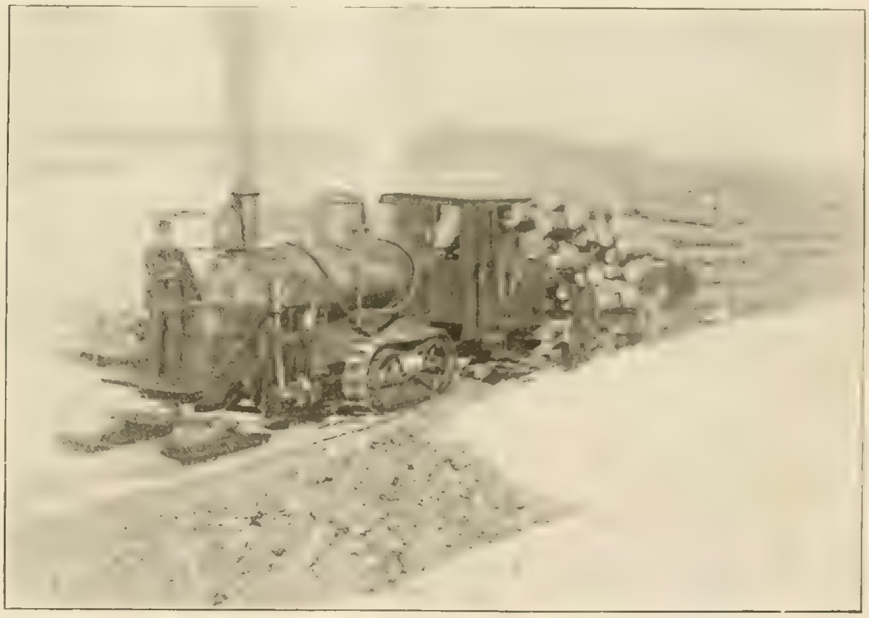
Questions Answered

CORRECT PRESSURE AT EQUALIZATION.

(00) F. C. D., Omaha, Neb., asks: How is it that in making a 20-lb. reduction on train line you get 53 lbs. pressure in driving brake cylinders? A. Because there is a sufficient volume of air stored in the auxiliary reservoir to expand into the brake cylinder and equalize at 53 lbs. per square inch. The total force pressing the brake shoes against the wheels is a certain percentage of weight holding the wheels to the rails and is the power developed by the brake cylinder, multiplied by, and transmitted through, the foundation brake gear. In order to prevent the liability of wheel sliding the forces tending to check the rotation of the wheel must not exceed the forces that are compelling the wheel to rotate and the maximum retarding effect is based upon a brake cylinder pressure of 50 lbs. per square inch when the plain triple valve is used. The sizes of brake cylinders and auxiliary reservoirs are so proportioned that 70 lbs. pressure per square inch in the auxiliary reservoir will equalize with the brake cylinder, with a proper piston travel, at 50 lbs. per square inch. As the auxiliary reservoir and brake pipe pressures are always equal, up to the point of equalization between the auxiliary reservoir and brake cylinder, you will readily see why a 20-lb. reduction from a 70-lb. brake pipe pressure results in a brake cylinder pressure of 50 lbs. per square inch, and if the 20-lb. reduction results in a 53-lb. brake cylinder pressure it must be due to a short piston travel, too large an auxiliary reservoir, or an incorrect air gauge.

GRADES, CURVES AND ADHESION.

(00) Subscriber, Apalachicola, Fla., writes: (1) In your August, 1908, issue, page 358 you speak of a 4 per cent. grade, what is a 4 per cent. grade? A. The expression means that the track has a vertical rise of 4 ft. in every 100 horizontal feet. This makes a very steep grade for a railway as the vertical lift in one mile is a little over 211 ft. (2) What is a 16-degree curve? A. Curves are generally designated by the angle which is subtended by 100 ft. A one-degree curve is such that an angle of 1 degree contains approximately 100 ft. of track and the radius is therefore 5,730 ft., or something over a mile. A sixteen-degree curve has 100 ft. of track taken in by the angle of 16 degrees. If the circle was complete it would, of course, contain 360 degrees, and if each 16 degrees contained 100 ft. there would be on the circumference or complete circle 2,250 ft. of track. This circle would have a diameter of 716 ft. or a radius of 358 ft. A railroad curve is, of course, only a very small portion of the whole circle which would be described if the radius was swept round through the whole 360 degrees. (3) The adhesion of a locomotive is spoken of at say 4.3; what does that mean? A. This is the ratio of adhesion and it is the proportion which the tractive effort of the locomotive bears to the total weight on the driving wheels. Suppose an engine carries a total weight of 100,000 lbs. on its drivers and that its calculated tractive effort is 25,000 lbs., then its ratio of adhesion is 4. That is, the tractive effort of the engine is to the weight on its drivers (called adhesive weight) as 1 is to 4. You get the ratio of adhesion by dividing the total weight on the drivers by the tractive effort. See

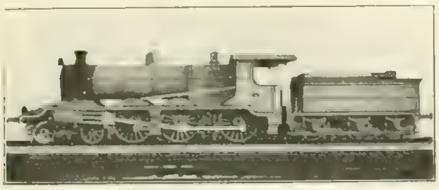


THINKING OF THE GOOD OLD SUMMER TIME.

article on this subject, called "The Frictional Limit," published on page 20 of our January, 1903, issue. Also see an article on "Grades, Profiles and Climbing," page 312 of our July, 1903, paper.

ASBESTOS BOARD LAGGING.

(00) G. H. G., Los Angeles, Cal., writes regarding the process of making asbestos boards for boiler lagging. What I want to know is how these boards are pressed into shape and whether it is done wet or dry.—A. The asbestos boards are formed in a mould so as to have the curvature of the boiler and they are pressed into this shape when wet. The sectional boiler covering as made by the J.-M. Johns-Manville Company consists of 85 per



TEN-WHEELER, BRITISH TYPE.

cent. of carbonate of magnesia combined with 15 per cent. asbestos fibre. When dry its heat-resisting properties and its insulating quality make it an excellent boiler lagging.

RESERVOIRS, CYLINDERS AND TRIPLES.

(00) F. C. D., Omaha, Neb., writes: Would you please let me know how I could obtain information as to correct sizes of driving brake cylinders, auxiliary reservoirs, and kinds of triple valves used with same?—A. In the air brake department, page 302, of the July issue of RAILWAY AND LOCOMOTIVE ENGINEERING there is a table which will give you the information desired.

SALT WATER IN BOILERS.

00. D. W. F., San Louis Obispo, Cal., writes: In your August issue the following paragraph occurs on page 364: "When condensed water first came into use for marine boilers it was found that the pure water had a deleterious effect upon the boiler sheets, causing serious corrosion that proved dangerous in some cases. The simple remedy of using salt water until the evaporation covered the sheets with a thin covering of scale was found to stop the corrosion." What effect do you think salt water would have if used in a locomotive boiler; would it make the engine leak or raise the water?—A. The meaning of Dr. Sinclair's remarks in "Editorial Correspondence from Abroad" was to the effect that distilled water, that is chemically pure water, attacked the clean sheets of the boiler, but that after enough salt water had been used to form very thin coating on the inside of the boiler, so that the sheets were covered, there was no more corrosion. Treated water such as is got from a water softening plant is not like distilled water as it still contains some traces of impurities, but the heavy incrusting matter has mostly been removed. Salt water in a locomotive boiler would soon cause a heavy deposit which would have to be constantly removed, but would not cause foaming or leaking. The presence of just enough coating to protect the sheets is not a detriment to the boiler, but anything beyond this in the nature of a heat resisting deposit is very objectionable.

Reflection of Light.

When a ray of light falls upon a highly polished surface we say it is reflected, that is, bent back, and the polished surface we speak of as the reflector. The reflection of light is analogous to that of sound or heat, but in all reflection there is a certain amount of loss, or, rather, diffusion. The light of day by which we see objects about us is really reflected light, but it is so broken up and diffused about us that we do not usually think of it as being reflected light. Light waves are so exceedingly short that even the most highly polished surfaces are rough and irregular as measured by the length of the waves of light.

Irregularly reflected light enables us to see the objects about us. If a reflector was absolutely smooth we should see, not the reflector but the object from which the rays of light came. It is the diffused light reflected from the clouds, the air and the earth, with the objects lying upon it that illuminates our rooms and enables us to see things upon which the direct light of the sun does not fall. Investigation, however, has proved that reflection obeys definite laws.

When a ray of light falls upon a polished surface it is called the incident ray and if it falls obliquely upon that surface it makes a certain angle with a line at right angles to the surface. Suppose you made a chalk line across the center of a billiard table and were to roll a ball obliquely against the cushion so as to hit it exactly where the line touched the side of the table. The angle made by the path of the ball with the chalk line would be called the angle of incidence. A ball so rolled would rebound away from the cushion, and its new path away from the cushion would be found to have made the same angle with the chalk line as its path of approach to the cushion had made. The angle of its path of rebound is called the angle of reflection, and one of the laws of optics is that the angle of incidence is always equal to the angle of reflection.

Now if the ball upon striking the cushion at the point where the chalk line ended, had there broken up, or had thrown off some small fragments, we would find that the larger bulk made up of what remained of the ball had obeyed this law of optics and had pursued a path in which the angles of incidence and reflection were equal. The small fragments striking the cushion which was not perfectly smooth, but which may be supposed to be an irregular surface, would, in endeavoring to obey the law, fly off in various directions and be scattered here and there upon the table. In this irregular action of the small fragments we have a sort of picture of the phenomenon of diffusion. To these fragments the cushion presented not the equivalent of a polished surface, but rather a rough one with innumerable facets upon which the fragments fell, and as each facet presented a differently placed surface, each fragment while securing a rebound angle equal to its incident path would necessarily be thrown outward over a more or less fan-shaped area and so diffused.

Danger of Air Navigation.

A few flights made successfully with flying machines set the prophets of progress predicting that in a few years all the transportation of the world would soon be made in the air. The Wright air ship was the most successful flying apparatus ever tried, but it came suddenly to grief in a flight attempted on September 17. By the breaking of the propeller shaft the machine suddenly became helpless when at a height of 75 feet and dashed to the ground, killing one of the enterprising occupants.

Railroad trainmen who have been looking forward to changing their occupation to enter upon the flying machine operating, will learn from the accident to the Wright flying machine that they might leave the dangers of locomotive operating for one that would have dangers more serious than collisions and track jumping. When a valve stem or main rod breaks the results are frequently very annoying, but the engine stops on *terra firma* without any jumping. The failure of any part of a flying machine would lead the whole thing to fall to the ground like a rocket stick, then woe to all on board.

HOSPITAL TRAIN USED IN WAR TIME.

A darkey describing the perils of various occupations, said: "If yous get into a railroad train smash, dar you are; but if you get into a steamship smash, you're nowhere." It might be added, if you are in an air-ship accident, you go somewhere in too great a hurry.

Air Brake Department

Handling Trains.

By Geo. W. Kiehm.

Nearly all railroads aid and encourage their employees, especially engineers and firemen, to become familiar with the construction and operation of the air brake.

The majority of engineers avail themselves of every opportunity afforded to study the air brake; others, however, are indifferent and neglect one, if not the most important, part of their occupation, but the time is now at hand when it is absolutely necessary for an engineer to have, if not a thorough, at least a good general knowledge of the air brake. If he has not, he will see others handling the trains of various lengths successfully while he is having annoyance and trouble, he does not understand, consequently he is very often busy explaining, that because his train was handled roughly some part of the equipment or some other individual is at fault.

A fair knowledge of the air brake coupled with a little thought and reason, will solve any ordinary air brake problem, and the new equipment found on the modern locomotive, and the changes in car equipments, make this knowledge and reasoning essential. Some engineers, upon being questioned concerning a rough stop with a passenger train, blame the E. T. engine brake, while others handle the same train and engine and make smooth, accurate stops. The absurdity of blaming the E. T. brake for a rough stop is apparent, while the fact is well known that this equipment accomplishes more with less apparatus than the brake previously used.

There is no doubt that the ordinary two application stop will result in a shock to a passenger train if the H5 or the H6 brake valves are used alone, as the G6 brake valve would be under similar circumstances, that is, by making a heavy initial reduction, and as the speed of the train is reduced sufficiently, placing the brake valve handle in release position long enough to force all the triple valves to release position, then bringing the handle to lap position to avoid overcharging the brake pipe, depending on the second or light application to bring the speed of the train down at the point the stop is to be made so the brakes can be released on the last turn of the driving wheels.

Should a train and an engine having the E. T. brake be handled in this manner, it will result in most anything but a smooth stop, as by this method of handling the brake valve the pressure in the driving and tender brake cylinders will not have reduced, and the train running against the modern locomotive with the brake set in full is similar to running against a stone wall.

To avoid this it has been a practice in some instances to disconnect the double heading or release pipe, the engine and tender brake would then release with the triple valves in the train, but this appears to be a very thoughtless and unnecessary proceeding, as the pressure in the driving brake cylinders can be reduced or exhausted entirely at any and all times, by means of the independent brake valve.

ard type quick-action triple with the same brake pipe reduction, which is due to venting brake-pipe pressure into the brake cylinders during service applications, and if the slack in the train is taken up before the automatic brake is applied those triples will surely run it [illegible] with a shock to the train, which they could not do if the train was stretched.

Making the first application before the throttle is entirely closed would prevent train from bunching, and with the long passenger train the brake can be held on lightly until the train has stopped.

When the independent brake is used to bunch the slack in the train it should be applied very lightly and the brake cylinder pressure gradually increased until the slack is all in. Applying this brake in full instantly will throw a severe shock into the train especially if the speed is low, and when the brake is released it should be graduated off and in this way the engine and tender will not have a tendency to jump away from the train while the train brakes are lightly applied.

ON THE LINE OF THE SAN RAFAEL & ATLIXCO RAILROAD.

Instead of being difficult to operate, the E. T. brake has decided advantages in this respect as the 10 and 12 inch brake cylinders on the head end of the train are emptied before the 14 and 16 inch cylinders on the rear cars and by holding the driver brake applied in release position of the brake valve it automatically guards against the engine and forward portion of the train pulling away from the rear cars while their brakes are not yet fully released. While a long heavy passenger train and a freight train should be handled similarly in some respects, there are times when it is better to have the train stretched than bunched when the automatic brake is applied, for instance, quite a number of the later type L triple valves, which have the quick-service feature, are in use and are found on the heavy cars on the rear end of the train. Those triple valves produce a higher brake cylinder pressure than the stand-

If used in this manner the brake will assist in making smooth stops anywhere that accurate stops are required.

After handling a train of 25 or 30 air-braked freight cars, one of 80 or 90 cars is an entirely different proposition, but they can be handled without damage to the cars or their contents. There are, of course, cases of unequal braking power and defective equipment which make it very difficult to handle a train without doing some damage to it. Because of the various ways in which freight trains are

condition of the brakes on them, a rule for handling one kind of a train can seldom be applied to another. There are, however, a few general rules which should be followed as closely as possible. One of the most important is, that with the long train the light application should be avoided, not only because but a certain per cent. of brakes will apply, but the light reduction can be considered in a measure as a test for a sticky triple valve, that is, if there is a sticky triple valve in the train that can be induced to assume the emergency position during a service application, the light reduction will cause it to do so. The reason is apparent, if the reduction is light the triple piston will be drawn against the slide valve gently and the slide valve may not be moved, and the feed groove will be closed, and on the following reduction, or when brake pipe leakage creates enough difference in brake pipe and auxiliary reservoir pressure to move the piston and slide valve, the piston will jump against the graduating stem, compress the spring, and throw the brake into quick action, where if the first reduction had been sufficiently heavy to move the slide valve when the piston was first drawn against it, the auxiliary pressure would have reduced by flowing into the brake cylinder.

The release is also more difficult following the light application which leaves a higher auxiliary reservoir pressure consequently more triple slide valve friction is encountered during the release, for after a 20 lb. application, there will be but 50 lbs. per square inch bearing on the slide valve, while after a 5 lb. application there will be 65 lbs.

The light application gives very little holding power for the amount of air used as considerable air is wasted in passing through the leakage grooves and in filling the space between the piston and cylinder and most of the resultant power is wasted in compressing the brake cylinder release spring overcoming the packing leather friction and drawing up the brake rigging, and owing to the absence of brake beam release springs, it requires a train movement to shake the shoes loose from the wheels, so that the light application is very often the cause of stuck brakes, stalled trains and broken couplings.

What is referred to as a light reduction is one less than 12 or 15 lbs., and with an initial reduction of this kind there can be no light applications.

VIEW OF THE LAWRENTINE HILLS NEAR STE. AGATHE, QUE.

There are different ways of releasing the brake. It can be released with safety at low speeds if the engine is equipped with the E. T. brake, or the combined automatic and straight air, and no locomotive should be allowed to handle cars without either. The E. T. Brake is not an experiment but a necessity in modern air brake service.

When the brake is released at low speeds the driver brake will be held applied. It can be applied in full by the independent brake if it is not, and the head end of the train will not drift away from the rear end before those brakes are released, thus preventing the loss of time and occasional damage to a train from starting in an unfavorable place where the only reason for coming to a stop is the danger of breaking in two by releasing.

The independent brake applied will also prevent the slack running out so fast, on short grades and curves, as to cause a severe shock or to separate the train.

As stated before, the independent brake can be used to bunch the slack in the train before applying the automatic brake. Yet there are times when it is better not to bunch the slack, for instance, if it is observed that there are a number of new cars in the rear of the train they are quite likely equipped with the type K triple valves and their quick service features give a higher brake cylinder pressure than the quick action triples, and the leverage on those cars has probably been increased from 70 per cent. of their light weight to 85 per cent., not by the type K triple valve, but by actual change in leverage in the foundation brake gear.

Therefore the brake cylinder utilizing this higher pressure and transmitting it to the shoes, through the increased leverage will give enough holding power to run the slack out again with as severe shock, and probably part the train, if the slack has been bunched before the application.

In handling a train of this kind it would be good policy to apply the brake while the engine is using steam closing the throttle after the application. In releasing this brake the independent brake would be used to release the driver brake with the train brakes and there would be no danger of parting the train if steam was not used until after the rear brakes released except possibly at very low speeds. When the driving wheels of a locomotive were locked on a grade it was at one time a case of releasing the brakes on the entire train or flattening the tires. With the independent brake it is only necessary to partially release the driver brake and as the wheels begin to revolve reapply with any degree of force desired. It has been demonstrated that trains can be controlled on any grade by the air brake alone if maintained in a reasonable state of efficiency, and this will in all probability be insisted upon in the near future, and what more could be desired than the independent brake to alternate with train brake and assist the retaining valves in holding the train, and the release of the driver brake to prevent heating the tires while the train brake is applied. The holding power of the brake is such that a train can be held on a fairly heavy grade while the brakes on the train are being recharged and in this way guard against a runaway due to a depleted brake system. A rule to be followed in the use of the independent brake is to apply with light applications gradually increasing the brake cylinder pressure, and to release gradually by short successive movements of the valve handle, remembering that the lower the speed the more holding power the same cylinder pressure will give due to the increased brake shoe friction.

For the same reason the driver brake should be partially released just before coming to a stop to relieve the coupler spring tension and the possibility of wheel sliding, and on ascending grades the driver brake should be released entirely as the stop is completed and reapplied lightly in case the train starts back.

Why not make the best of what you have? Since you cannot grasp that which you wish, why let what you have slip through your fingers.—*Heartsease.*

Electrical Department

Storage Batteries.

By W. B. Kouwenhoven.

Storage batteries or electric accumulators, as they are sometimes called, are used for the storage of electric energy which may be used at a future time. The part they play in a railroad power house is similar to that of the water storage tank of a pumping station. Without the tank the pumps would have to operate twenty-four hours a day and their capacity would have to equal the maximum load. Moreover the efficiency of the pumps would be very much reduced owing to the widely varying loads to which they were subjected.

Where a storage tank is used the pumps need to have only the necessary capacity for the average demand, and can be operated at practically full load all the time. When the demand for water is below the average the excess water from the pumps is stored in the tanks. When the demand is above the average the tank supplies the excess, and in addition tends to maintain uniform pressure in the mains.

Wherever electric generators are operated without storage batteries they are subjected to the maximum or peak of the load and also to all the variations of the load and their total capacity must be equivalent to the highest peak. Upon the addition of storage batteries to the plant the generator supplies only the average load. During periods of light loads the batteries are charged by the generators, and when the heavy load comes on, the batteries unite with the generators and together they carry the load. This relieves the generators from the necessity of sustaining all the peaks of the load by itself. This arrangement is known as floating storage batteries on the system. It tends to maintain the voltage at the third-rail very much more nearly uniform, and permits the operation of the generators at a very nearly constant load which is conducive of a high efficiency. It also removes the sudden strains from the engines due to widely varying loads.

This property of a storage battery makes it a valuable asset to any electric road. They are used in a number of railway systems to help the generators during the rush hours and in case of a shut down of the generator end of the station they usually can carry the load for several hours. Thus it is evident that they are an insurance against a complete shut down of the entire power supply.

WHAT THE BATTERY IS

A storage battery is a voltaic couple that is reversible. A voltaic couple consists of two substances which when immersed in a liquid have a difference of voltage between them. Any couple that is capable of recharging after exhaustion by passing through it an electric current in the opposite direction to that of the discharge current constitutes a storage battery or an electric accumulator.

There are very many voltaic couples that fulfill this condition and may be employed as storage cells, but with the two exceptions of lead against lead peroxide, and of lead against zinc, none have proved commercial successes. The iron nickel cell for automobile propulsion can never compete with the lead-lead cell for central station service.

The lead-lead battery is the most common type. It consists of two elements, the positive, the negative and the electrolyte. The positive is lead peroxide and the negative, sponge lead. They are easily distinguished, being different in both hardness and color. Lead peroxide is a comparatively hard substance of a brown chocolate color. Sponge lead, on the other hand, is very soft and is light gray in color. Sponge lead is not ordinary metallic lead, but is an allotropic form of the metal. These two form an active couple when immersed in dilute sulphuric acid, and this liquid is called the electrolyte.

Exactly what goes on during the periods of charge and discharge is not fully known. During the discharge small quantities of sponge lead and lead peroxide are changed to lead sulphate. During the charge this lead sulphate is changed back to lead peroxide and sponge lead and the process is reversed. A charged cell is one in which the positive plate is coated with lead peroxide and the negative plate with sponge lead. A discharged cell is one in which lead sulphate has been formed on both elements, although it only partially covers them. Electricity itself plays no part in this whatever, except that during discharge the electric current is a product of the chemical change, and during charge it acts as a reducing agent.

The active area of a plate is the length multiplied by the breadth multiplied by two, as both sides of the plate are active. The unit of battery

EXPERIMENTAL TRAIN FOR TESTING BRAKES ON THE ARLBERG RAILWAY, READY TO START FROM BRAZ, AUSTRIA.

capacity is the ampere-hour, and the rated discharge is at an eight-hour rate. For example, if a battery has a capacity of 120 ampere-hours, it will give a continuous current of 15 amperes for eight hours. If the discharge is maintained at a higher rate than this the ampere-hour capacity of the battery will be lowered materially. However, if the battery be allowed to remain idle without recharging for a time it will recuperate and a further discharge may be obtained.

A single storage cell consisting of a lead peroxide plate and a spongy lead plate immersed in sulphuric acid will give when fully charged a little over two volts. The ampere-hour capacity of the cell depends upon the active area of the plate. To obtain the voltages necessary in railroad work requires a large number of individual cells. These are connected in series, and each cell must have sufficient area to maintain the ampere-hour capacity.

Spongy lead and lead peroxide both exist in a finely divided or porous state, and do not possess sufficient strength or rigidity to support themselves, and they have a low electrical conductivity. A lead frame work, known as a grid, is used to support the elements and to furnish the necessary conductivity.

A grid must meet a number of requirements, as follows: First, the current must flow equally throughout all portions of the grid; second, the grid must allow for the expansion and contraction of the active material during charge and discharge, and we may say in passing that more battery trouble originates from this cause than any other; third, the active material should be firmly attached to the grid and in good electrical contact therewith; fourth, the grid must not be attacked by the acid; fifth, there should not be any local action between the grid and the active material; sixth, ample provision should be made for the circulation of the electrolyte; and seventh, the greatest possible area per unit weight should be provided.

There are two types of plates, the Planté and the Faure. In the Planté the lead plate is first formed from sheet lead of very good quality. The plate is then treated by either a chemical or an electro-chemical process and the surface is changed to lead peroxide, thus producing the positive plate. The negative plate is formed from the positive plate by a further treatment which reduces the surface to sponge lead. Various schemes, such as grooving and scoring the surface, are used to increase the active area of the plates.

The Faure type, sometimes called the pasted plate, consists of a lead grid provided with recesses. The active material in a finely-powdered and porous state is forced into these depressions or recesses under heavy pressure, lead peroxide being used for the positive plate and spongy lead for the negative.

Each type of plate has its advantages and disadvantages and each fulfills certain conditions. The Faure type has the greatest active area per unit weight, but the material is liable to disintegrate and fall to the bottom of the cell. The methods of manufacture of plates are legion, and many of the best processes are kept secret and are never exposed to the patent office or to the general public.

The electrolyte used is sulphuric acid made from sulphur. Acid made from iron pyrites should never be used owing to the likelihood of its containing impurities. The acid should be as nearly chemically pure as possible. Concentrated acid has a specific gravity of about 1.84, but for battery purposes the acid is diluted with distilled water until the specific gravity is 1.24. The addition of water raises the temperature of the mixture and it must be allowed to cool before being used. During discharge the specific gravity falls to about 1.18, and practice has demonstrated that it should never be allowed to fall below 1.15.

A storage cell when fully charged has an electro-motive force of about 2.5 volts. On discharge this falls very rapidly to about 2.0 volts, and continues almost constant until near the end of the discharge, when it falls rapidly. It should never be allowed to fall below 1.8 volts, which corresponds to a specific gravity of the electrolyte of about 1.18. If the discharge is continued the voltage falls lower, lead sulphate is formed in quantities. Lead sulphate is a very good insulator and increases the resistance of a cell very materially. It offers a high resistance to the passage of the charging current, and it is impossible to completely reduce a badly sulphated plate back to its original condition. There is no satisfactory remedy for removing it from the plate, and the plates are thus very easily ruined. In the next issue the care, operation and maintenance of storage batteries will be considered.

Driver's Cab Signal.

A form of audible and visual cab signal is in use on the Whitney-Fairford branch of the Great Western Railway of England. The installation has been made by the Western Syndicate, Ltd., and consists of a device in the cab of the engine which responds to an electric connection made at or near the spot where the distant signal is placed. The "danger" indication is given by the blowing of a small steam whistle in the cab and the display of a red card in a box, bearing the word "Danger." The "all right" is indicated by the ringing of an electric bell on the engine and the display of a white card in the box.

In the case of the "danger" apparatus, the whistle valve is normally held shut and so prevented from sounding by two electro-magnets which are energized by a battery carried on the engine. Breaking this circuit causes the whistle to blow and the red card to appear.

The track apparatus consists of a specially designed central rail insulated on wood, either 60 or 40 feet long, as may be required. This central rail has sloping ends and is called the ramp. A suitable shoe carried on the end of a short lever under the engine, slides up on, over and down each ramp along the line as the engine proceeds. In passing over the ramp, the shoe is pushed up about 1½ ins. and this movement breaks the battery circuit on the locomotive and the "danger" indication is given in the cab The normal position of this shoe keeps this circuit closed.

When the "all right" indication is to be given, the action of the signalman in throwing the distant semaphore to "clear" closes a switch in the signal tower and the closing of this switch makes electrical contact with the tower battery and the insulated rail of the ramp. The ramp is now electrically charged, if one may so say. The shoe under the engine when passing over the ramp, although it breaks the engine battery circuit, picks up current from the ramp, as from a third rail system and energizes a second pair of electro-magnets on the engine, and these hold the armature governing the whistle, which the first two de-energized magnets on the engine battery circuit had just let go. In this way, when the ramp is electrified from the tower as the distant signal is set at "clear," the danger whistle cannot sound.

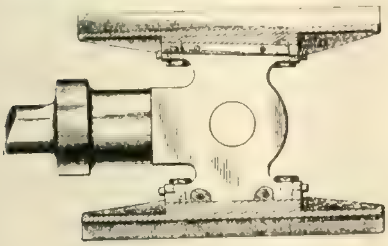
The ringing of the "all right" bell is accomplished by having a polarized relay on the circuit in which are the two magnets which are energized by current from the ramp. This polarized relay is energized at the same time by the ramp current and it closes a second battery circuit on the engine and this rings the bell. Both bell and whistle, when either is once sounded, will continue to sound until stopped by the definite action of the engine driver.

In this way he is compelled to take heed of and perform an act as either one of the signals is given. The failure of the apparatus gives the "danger" indication. Failure of the tower battery or connections, or the presence of grease, dirt, frost or snow on the ramp will cause the "danger" signal to be given on the engine. The ramp must therefore be kept clean and the whole apparatus maintained intact. This audible signaling system is being tried on the Midland Railway and it is being experimented with in South Africa and Italy.

Patent Office Department

CROSSHEAD.

H. H. Walck, Chambersburg, Pa., has patented a crosshead for locomotives, No. 896,339. The device embraces a head

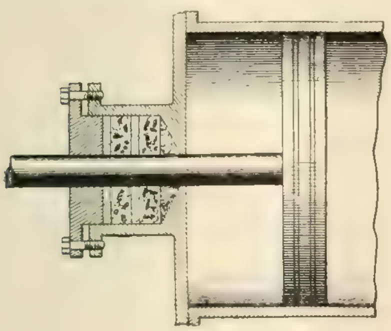


NEW CROSSHEAD DESIGN.

or body, upper and lower shoes, a dovetail rib and groove connection between the head or body and each shoe extending longitudinally of the crosshead. There are attaching bolts or screws, some of which pass vertically through the parts and some horizontally through the parts, and locking devices engaging the screws or bolts.

PISTON PACKING.

A metallic packing for pistons has been patented by S. Barnett, Puyallup, Wash., No. 894,791. The packing comprises alternate layers, one of the layers consisting of sawdust and the other comprising a mixture of pellets of zinc, lead, tin and

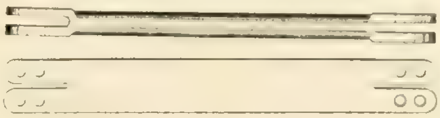


METALLIC PISTON ROD PACKING.

copper, brass, borings and graphite. The packing is said to combine the elements of economy and durability.

CONNECTING-BAR.

An improved pressed-steel connecting-bar has been patented by Mr. Neil McInnes, Allegheny, Pa., No. 840,237. As will be seen by the accompanying illustration, the bar consists of a pressed-steel connection comprising a blank slotted and perforated at its ends and pressed to provide a body portion, the side walls of which are deflected toward each other to bring them into vertical parallel relation. This pressing of the blank provides a body portion of great strength and

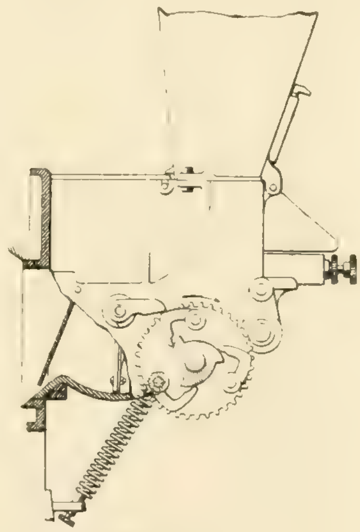


FOLDED CONNECTING BAR.

rigidity, and facilitates its attachment to the elements to which it is to be secured.

MECHANICAL STOKER.

A mechanical stoker has been patented by J. A. Caldwell, Montclair, N. J., No. 891,904. The device embraces a shovel compartment, an oscillating shovel mount-

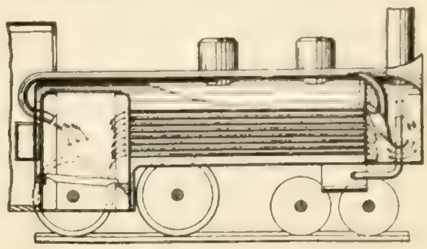


ARRANGEMENT FOR STOKER.

ed therein, means for oscillating the shovel, a pivoted damper, means for intermittently connecting the damper to the shovel, oscillating means to swing the damper on its pivot in advance of the fuel-throwing movement of the shovel. There are also means to automatically release the damper from the shovel oscillating means when the throwing movement of the shovel is completed.

SMOKE CONSUMER.

A smoke-consumer has been patented by J. Ryan, Grand Rapids, Mich., No. 896,250. It embraces, in combination with a boiler and firebox and smoke-chamber, a pipe longitudinal of the boiler with its back end entering the firebox, a branch pipe leading from the smoke-chamber into the longitudinal pipe, a bell-shaped funnel at the front end of this pipe, a bell-shaped valve in the funnel, a plunger slidingly secured at one end of the main pipe and secured at the other end to the valve. There is a spring on the plunger to actuate the valve in one direction,



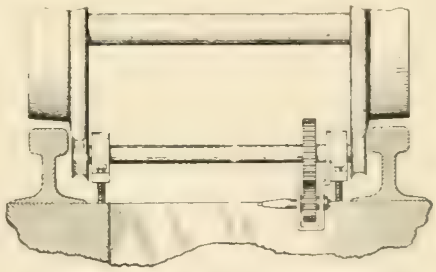
SMOKE CONSUMING DEVICE.

and a rod to actuate the valve in the other direction.

Nothing is more disgraceful than that an old man should have nothing to show to prove that he has lived long, except his years.—*Seneca.*

VALVE-SETTING MACHINE.

R. E. Wyllie and J. D. Twohig, Amarillo, Texas, have patented a Valve-setting machine, No. 894,995. The device embraces a shaft, rollers adapted to engage the driving wheels of a locomotive mounted on the shaft, bearings supporting the shaft and means for vertically adjusting the bearings and means for transmitting motion to the shaft.



MACHINE FOR VALVE SETTING.

The Great Western Railway of England is said to be the scene of some new records in fast locomotive running. The distance from London to Cornwall was made recently in 233 minutes, an average speed of 63.2 miles per hour. Another special performance is claimed of a run of 247 miles in 227 minutes, an average of 65.4 miles per hour. It is generally noted that runs of this kind are of a special and spasmodic kind, and are not in any way of benefit to railroad traffic. Records of locomotives running are of little or no value unless the record is a continuous one, the same distance being covered in the same time day after day.

CONCERNING THE DERAILMENT OF TENDERS

Cure for Tender-Truck Derailments.

By J. F. Walsh,
Superintendent of Motive Power,
Chesapeake & Ohio Railroad.

We have our own individual opinion as to the cause but as mechanical department people, whatever the cause may be, we are expected to find a cure. I am therefore sending you herewith a blue print of a model made to scale and representing a tender with 7,000 gallons water capacity and 10 tons of coal.

To any one interested specially in determining the cause of tender truck derailments I would suggest that they make a model of thin board on the full lines shown on the blue print, using only to start with the side bearings marked 30 ins. from center of center plate to center of side bearing, or 60 ins. from center to center of side bearings.

Place a thumb tack at the point marked "C. G." (center of gravity), attach to the thumb tack preferably a thin rubber band, draw the band tight in line with the center of the track then slowly move it to a point indicated by the line which intersects the side bearing; about the time it has reached that line the wheel at the opposite side will have been found to have moved at least the height of the flange above the rail, thus showing quite plainly that with certain speed and track conditions it will throw with great force the weight of the tender upon either of those side bearings and the wheel flange will be carried above the rail, and before it can again drop in behind the rail another movement of the tender has occurred which will bring the flange either on top or outside of the rail, resulting, of course, in derailment.

After that experiment has been made remove the temporary side bearings from the model and place it in the position provided, marked 18 ins. from center of center plate to center of side bearings, or 36 ins. center to center of side bearings, then using the rubber band again as mentioned above it will be found quite impossible to bring pressure enough there to disturb in the slightest the position of the wheel upon the rail.

The above information is given, not from a standpoint of theory alone; but from actual experience and the result of investigations and study, not to mention uneasiness and uncertainty which preceded the actual cure of the disease.

Originally our tender truck side bearings were spaced 60 ins. from center to center. Later on we reduced it to 56 ins. center to center, from which we found some relief, but not a cure.

Again working in the same direction we reduced our side bearing spacing to 48 ins. center to center, with considerable relief, but not a cure.

Finally, after much thought and advising with the best authorities in the country, most of whom concluded that the side-bearing spacing was all right, and the track was all wrong, we concluded to again reduce the side-bearing spacing on the front tender truck of our tenders, which we did by locating them at a distance of 36 ins., center to center of side bearings; leaving the side bearings on the rear truck spaced 48 ins., center to center, which has worked a complete cure, so far as front-tender truck derailments are concerned.

As mentioned above, any one who will go to the trouble of making a model can without any question of doubt satisfy himself as to the correctness of our conclusions.

In addition to locating the side bearings so as to measure 36 ins., center to center, on the front truck, we suggest the advisability of arranging for a comparatively short side bearing on the truck bolster with a long leg side bearing on the body bolster, giving a greater tendency to bring the blow from the body of the tender, or the blow caused by irregularities in the track in such a way as to tend always to keep the effects of it towards the center of the track instead of towards the rail.

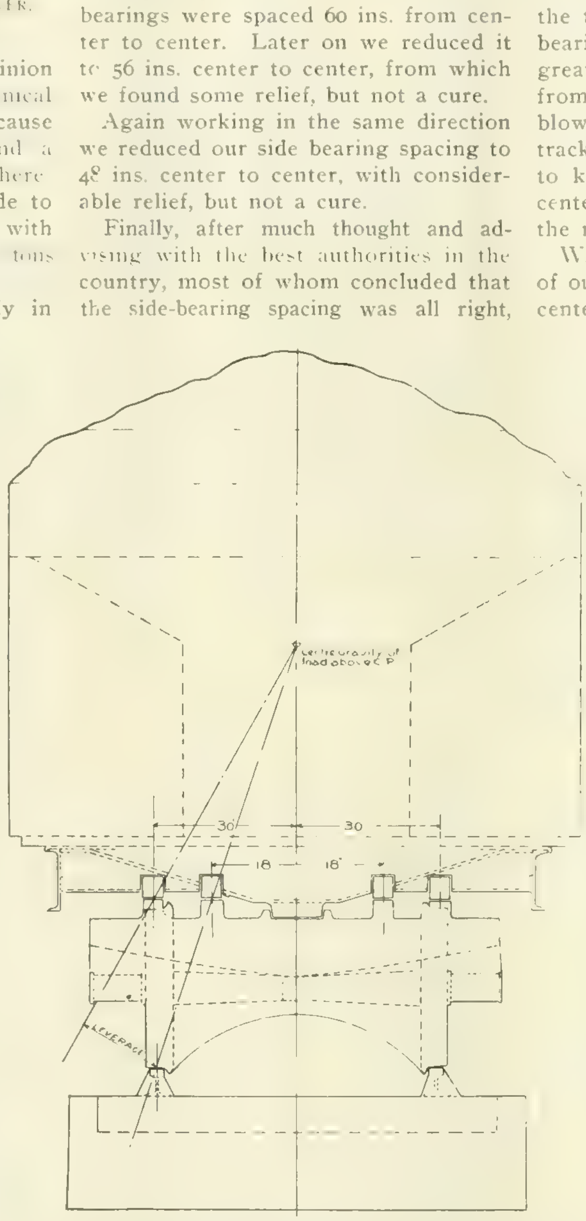
With the side bearings on the front of our tenders spaced 36 ins., center to center, we allow ⅛ in. vertical clearance on each side.

With side bearings on rear trucks of our tenders spaced 48 ins. center to center, we allow ¼ in. vertical clearance on each side.

By the above vertical spacing it brings the side bearings on either side in contact at the same moment.

It may be said, and very truly, that the removal of the side bearings from the front truck of the tender will avoid derailments of front trucks; but, with the high capacity tenders, and the high speed of trains, that cannot be done unless by distortion of the tender frame itself, and probable destruction of the rear truck, if not the derailment of it.

In working out the above we must give credit to Mr. J. J. Ewing, our mechanical engineer, for having worked diligently and faithfully, which enabled us to reach the results represented in the above.



OUTLINE OF CARD WHICH MAY BE CUT OUT AND SUSPENDED AT CENTRE OF GRAVITY TO ILLUSTRATE TILTING OF TENDER.

This is an easily performed experiment of which Mr. Walsh speaks. Anyone who desires can try it by making a drawing as here shown, using the full lines of the figure and balancing it upon a thumb tack as described.

Derailment of Tenders.

By T. A. Lawes,
Mech. Eng., N. Y. C. & St. L. R. R.

In the August and September numbers of Railway and Locomotive Engineering there are able and I believe sound contributions on the subject of the derailment of tenders. I propose in this article to extend the examination of the causes of derailment to other items not touched upon in the previous communications. The causes generally given for derailment are, in part, as follows: Bad track, the use of side bearings on front trucks, the omission of side bearings on front

trucks, truck bolsters not clearing arch bars, wheel base too short, center of gravity too high, rigid coupler at rear of tender, side bearings wider than rails.

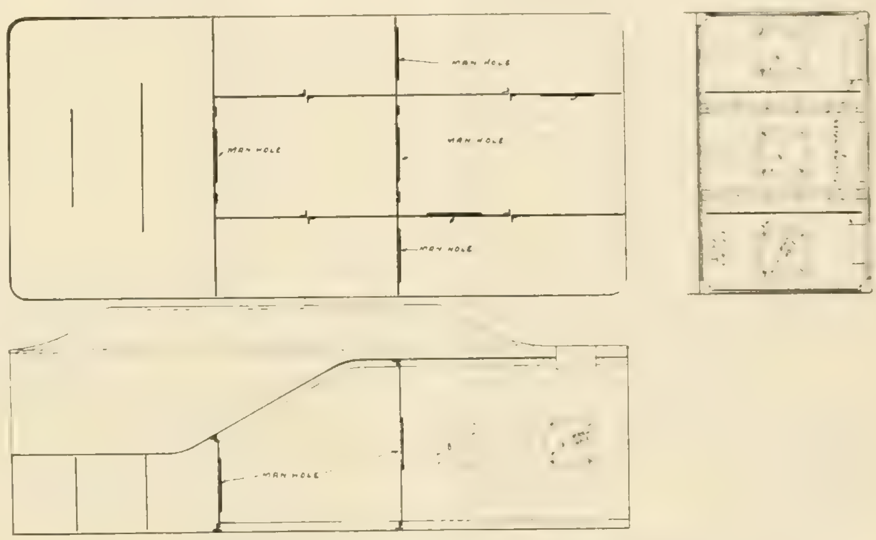
In the Spring the action of frost is bound to make track bad, and that bad condition will continue until the track is lined up. The writer believes that it is a poor excuse to lay derailments to bad track, which, while it allows the engine to pass over safely, derails the tender. I have never been able to find a convincing reason for the use of side bearings on front trucks. On the four-wheel engine truck carrying a heavy load, side bearings are not necessary. On an uneven floor, a three-legged stool is stable while a four-legged stool is unstable. The two side bearings on the rear truck with the center bearing on the front truck make a stable condition. With side bearings on the front truck, however, we have an unstable condition. On bad track, side bearings on the front trucks cause strains which would not be there if the side bearings were omitted.

On account of large and heavy capacity tanks requiring large spring space, designers of locomotives sometimes do not make bolsters to clear the bottom arch bar sufficiently. In the rolling of the tank, if the bolsters do not clear the arch bar, the tendency is to lift the wheels off the track. It would be well if engine tanks had longer wheel bases. However, as so many round houses were built when engines were shorter than they are now it is impossible to increase the length of the wheel base without increasing the length of the round house. Certainly the value of a longer wheel base cannot be questioned. Radial couplers, with which modern tenders, as a rule, are equipped, are of great advantage in passing curves.

DERAILMENTS.

In my experience derailments take place most often at high speed with the tank about two-thirds full of water. As a rule, examination shows the tank to be in good condition and low places on the track. Generally it is the rear truck that derails. A tank (capacity of 6,500 gallons) containing 5,000 gallons of water, weighing about twenty tons, which is on a track having a succession of low places, oscillates and throws the water from one side to the other,—twenty tons of water allowed to go where it will. In the stowing of cargo on ocean vessels great care is taken to place each article so it cannot shift when the vessel rolls, thus endangering its stability. The shifting of water in an engine tank can largely be prevented by the use of longitudinal baffle plates. Baffle plates arranged at right angles with the track are in general use but longitudinal plates are limited in use.

The drawing I have sent shows a tank with two cross baffle plates, and two longitudinal baffle plates, dividing the tank into seven compartments. Access is had from one compartment to another through an eighteen-inch man-hole, closed with a plate held by four bolts. Access to the bolts is had through the small holes which are open. The plates have openings at the bottom to admit the passage of water from one compartment to another. In a test, a float placed in a tank, without longitudinal plates, and running at the rate of forty miles an hour, had a maximum movement up and down of ten inches. In a tank equipped with the plates, the float had two inches maximum movement.



ARRANGEMENT OF SWASH PLATES IN TENDER.

In conclusion, a passenger engine tank of large capacity should, in my opinion, have longitudinal baffle plates, side bearings omitted on front truck, truck bolsters with proper clearances on arch bars, radial couplers, distance between side bearings less than the distance between rails.

We have been informed that the Falls Hollow Staybolt Company of Cuyahoga Falls, Ohio, have recently made a large shipment of Falls Hollow staybolt iron to the Great Southern of Spain Railroad Company; also to the Australian Government Railways at Brisbane, Australia; the Payta-Piura Railway at Payta, Peru, and the Western Railway of Havana, Havana, Cuba. They also have an order on hand for a large quantity of Falls Hollow iron for shipment to the Ferro Carril de Entre Rios Railway of Argentine, and also for the North Brabant German Railway Company, Gennep, Holland. The ten locomotives recently ordered by the International & Great Northern from the American Locomotive Company, are to be equipped throughout with Falls Hollow bolts, as well as the six locomotives ordered from the Baldwin Locomotive Works by the Iowa Central Railway, and one locomotive ordered by the M[illegible] Railway. The De Glehn Compound recently built by the American Locomotive Company for the Paris Orleans Railway of France was equipped with these bolts.

Conserving the Eyesight.

The average man hates paternalism in government or the tendency to take from him the management of his own affairs. He agrees with the wise saying "That they who are governed least are governed best."

Women, on the other hand, incline towards constant meddling, even with petty details. Railroad men often complain bitterly about the strictness of vision test imposed by examiners, but they would have more reason to complain if a board of women had control over the eye tests. Such a community of women have tried lately to supervise the vision of school children in New York, and they ask that hereafter no text-book be used in the schools printed on calendered paper, which casts a glare, that none of the illustrations in the books or elsewhere be printed from halftone cuts; that no electric globes except frosted ones be used in the schools; that all lights in night schools be provided with green shades, and that each pupil be required to hold his book when studying at an angle of 45 degrees, and that when reading aloud he be required to look up frequently from the page.

The way out of our narrowness may not be so easy as the way in. The weasel that creeps into the corn-bin has to starve himself before he can leave by the same passage.—[illegible]

THE QUALITY OF HEADLAMP LIGHT

It is difficult to give any hard and fast rule as to what is meant by the quality of artificial light and it may sound something like a truism to say that artificial light should be judged according to its tendency to make things appear as they really are. This seems to be a generally satisfactory standard to apply when it is remembered that many of the seemingly wonderful effects produced in theatres depend for their effectiveness upon the skillful manipulation of light. In recognition of the fact that the quality of the light plays an important part in determining the effect produced, many shops where ladies' dress goods are sold provide a show room where daylight is excluded and the appearance of the fabrics is observed under the rays of an artificial light.

An interesting demonstration of the effect produced by light from different sources may be had by a very simple experiment. At one of the gas fixtures supply houses in the city there was in a dark room, a screen of white silk lighted from behind by four illuminants. Each one of these was in a box so that none of the various kinds of light could mix. Each shone only upon the portion of silk in front of it. The result was that the whole silk curtain appeared like a window with four frosted glass panes of different hues. The ordinary house illuminating gas produced a yellow effect on the silk. An incandescent electric light gave a characteristic tint, the Welsbach light imparted a green color to the curtain and the light from an acetylene flame produced practically no alteration in the color of the white silk. It showed the article as it was.

These facts show in a general way what is usually meant by the quality of a light and the quality is an important factor in determining the use to be made of any form of illuminant. Turning our attention to the locomotive, we may say that broadly speaking a headlight is used to illuminate the track in advance of the locomotive, in order to show an open switch or any obstruction on the track. It is also of use to persons in the vicinity of the track as it indicates the approach of a train. If the light is strong enough to fulfil these conditions and to reveal the presence of danger soon enough for the engineer to make a stop, it is for all practical purposes an efficient light.

The oil-burning headlight, it is safe to say, has not satisfactorily met these conditions to the full, especially in fast passenger service. Part of the want of efficiency with the oil light may be traced to badly mounted lamps, which, as engines became larger and boilers higher, was still carried on top of the smoke box. Many of our more modern engines have the headlight placed at the centre of the smoke-box door, but the oil lamp even when reinforced with a powerful reflector, and well placed, is at best too feeble a source of light for the exacting conditions incident to fast passenger runs.

The natural remedy for the defects of the oil lamp would be the production of a much more powerful light, of which there are several kinds in existence, and while such a light might be very satisfactory to the occupants of the cab as far as track illumination is concerned, it is advisable to consider the effect which the more or less concentrated beam of strong light from any head lamp necessarily produces on those who come within its range, and also the quality of the light to show things as they really are. The color that a horse and cart is, or appears to be, when on the track in front of a locomotive is not important. The essential in the matter is that the obstruction be seen at a sufficient distance ahead to allow for a stop, and it is of the greatest advantage if this can be accomplished without, at the same time, dazzling the driver of the rig, and so possibly rendering his movements uncertain. But in the matter of signal observance where colored lights are used, the quality of light from the headlamp and its ability to show things as they are, is of the greatest importance.

Headlights as we use them are practically unknown in Great Britain, and there level crossings are few and far between and usually specially protected, and in that country any serious attempt at track illumination is left out of consideration. The colors of signal and switch lights in England are not affected by the feeble signal light on the engine falling upon them. There is no dazzling or blinding effect produced upon the crew of either train when two trains pass. In this country where conditions are very different the problem of proper track illumination is one which has to be solved. The increase of traffic, and the high speed of trains, the introduction of block signals, the train signal system and the presence of level crossings, makes the solution of the problem for American railroads one in which all the conditions must be fully considered and adequately dealt with, and the result may have to be something in the nature of a compromise.

Some years ago Tyndall made a series of experiments on the fog-piercing qualities of variously produced lights, and determined that the gas flame was the most satisfactory for that purpose. Although the conditions which are present in marine lighting do not occur in the same form in railway practice, yet the fact that fog is encountered on land as well as at sea must have some weight in determining the quality of the light used in this form of railroad work.

In brief, we may say, some of the principal requirements of a locomotive headlight are that the light from it shall be powerful enough to illuminate the track far enough ahead to permit of an emergency stop. That the light shall not be so brilliant as to cause temporary blindness or bewilderment in those upon whom it falls, that in the matter of signal observance it must not alter or modify the colors of the lesser lights which come into its field, and that it shall be as effective a form of light as can be devised for foggy or snowy weather.

Among the various sources of lights available for headlights the use of acetylene gas seems to have several points which are worth considering. A storage system of dissolved acetylene is now being used in locomotive work by several railroads, with very satisfactory results. The acetylene flame is much more powerful as a source of light than that from oil, and its greater power extends the range of vision of the engineer without seriously inconveniencing those on a train moving in the opposite direction, and without bewildering those who come within the beam. The quality of the light, or, one may say, its approximation to sunlight is such that it does not fade out or modify the colored lights upon which it falls, and its fog-piercing qualities have brought it to the attention of the maritime world, and the production of acetylene gas by the process now in vogue has brought its cost down to very satisfactory figures. The whole headlight question has aroused a great deal of interest in this country and in Canada and it is certain that the possibilities of acetylene gas in this connection are well worthy of serious consideration.

The twentieth annual report of the Interstate Commerce Commission shows that the number of passengers carried by the railways during the year ending June 30, 1907, was 873,905,133, this item being 75,959,017 more than for the year ending June 30, 1906. The passenger-mileage, or the number of passengers carried 1 mile, was 27,718,554,030, the increase being 2,551,313,199 passenger-miles. The number of tons of freight shown as carried (including freight received from connections) was 1,796,336,659, which exceeds the tonnage of the year 1906 by 164,962,440 tons. The ton-mileage, or the number of tons carried 1 mile, was 236,601,390,103, the increase being 20,723,838,862 ton-miles. The number of tons carried 1 mile per mile of line was 1,052,119, indicating an increase of 69,718 ton-miles per mile of line in the density of freight traffic.

A gentleman was traveling in the north of Scotland. When he reached his destination he discovered that he had left his waterproof in the compartment. He hurried, as the train was leaving, and shouted: "Is there a black macintosh in there?" One of the gentlemen replied, "No; they are all Macgregors."—*Tid-Bits.*

Items of Personal Interest

Mr. James Martin, master mechanic of the Liberty-White Railroad at McComb, Miss., has resigned.

Mr. N. E. Baker has been appointed signal engineer of the Illinois Central vice Mr. M. H. Hovey, resigned.

Mr. W. M. Saxton has been appointed locomotive foreman of the Grand Trunk Pacific Railway at Bigger, Sask.

Mr. A. C. Merry, purchasing agent of the Chicago Terminal Transfer, has resigned, and his office has been abolished.

Mr. John H. O'Brien, master car builder of the Mexican Central and in the services of that road for 25 years, has resigned.

Mr. H. C. Ackworth has been appointed storekeeper of the Erie Railroad at Kent, Ohio, vice Mr. H. E. Lind, transferred.

Mr. John Stewart, inspector of locomotives and cars on the Intercolonial Railway, has resigned, and the position has been abolished.

Mr. G. P. Robinson has been appointed supervisor of boilers of the New York Central Lines, vice Mr. Geo. Wagstaff, resigned.

Mr. H. C. May has been appointed master mechanic of the Louisville & Nashville at South Louisville, Ky., vice Mr. W. L. Tracy, resigned.

Mr. C. L. Webster has been appointed master mechanic of the Canadian Northern Ontario Ry., with offices at Parry Sound, Ont., Can.

Mr. Frank Howard, general foreman car department of the Wabash Railroad at Toledo, Ohio, for 23 years, has resigned and will engage in private business.

Mr. W. M. Armstrong, locomotive foreman on the Canadian Northern Ry., has been appointed locomotive foreman, at Edmonton, Alta, vice Mr. F. Knight, transferred.

Mr. H. E. Nichols has been appointed traveling engineer over the southern district of the Chicago, Minneapolis & St. Paul Railroad, with headquarters at Perry, Iowa.

Mr. Chas. Anderson has been appointed general foreman of the car department of the Wabash Railroad, with headquarters at Toledo, Ohio, vice Mr. Frank Howard, resigned.

Mr. E. F. Jones has been appointed acting master mechanic of the Chicago & Western Indiana and the Belt Railway of Chicago, in place of Mr. P. H. Peck, who has been granted a leave of absence.

Dr. Angus Sinclair, chief editor of RAILWAY AND LOCOMOTIVE ENGINEERING, returned to New York last month. He is looking remarkably well and says he feels as well as he looks. He enjoyed his trip to Great Britain very much but made his visit one of social calls among relations and old friends rather than one of official visits to railway centers. He took the opportunity of testing the golfing qualities of some of the inhabitants of the heathery hills of Scotland and in these encounters the "chief" gave a good account of himself. Dr. Sinclair is much benefited by his summer outing but remarked in the office on his return that the finest sight he had seen abroad was the harbor lights of old New York from the deck of the incoming "Etruria."

The title of Mr. D. J. Durrell, general foreman of the Pittsburgh, Cincinnati, Chicago & St. Louis, and of the Cincinnati, Lebanon & Northern, at Cincinnati, Ohio, has been changed to that of master mechanic.

Mr. E. W. Kolb, formerly supervisor of signals of the Nebraska division of the Union Pacific has been appointed engineer of electrical signals of the Chicago, Rock Island & Pacific.

Mr. John Schrader, formerly foreman of the car department of the New York Central at Buffalo, N. Y., has been promoted to general foreman of the Mott Haven Yards, New York City.

Mr. W. F. Girten, formerly general storekeeper of the Central Railroad of New Jersey, has resigned and accepted a like position with the Delaware, Lackawanna & Western at Scranton, Pa.

Mr. C. B. Williams has been appointed general storekeeper of the Central Railroad of New Jersey, with headquarters at Elizabethport, N. J., vice Mr. W. F. Girten, resigned.

Mr. A. H. Morris has been appointed general storekeeper on the Union Pacific at Portland, vice Mr. A. H. Cunningham, resigned after having been with the company for the past 27 years.

Mr. F. Knight, formerly locomotive foreman on the Canadian Northern Ry. at Edmonton, Alta., has been appointed locomotive foreman on the same road at Port Arthur, Ont., vice Mr. G. H. Hedge, promoted.

Mr. Frank T. Hyndman, formerly mechanical superintendent of the New York, New Haven & Hartford Railroad, has been appointed eastern railroad representative of the S. F. Bowser & Co., Inc., of Fort Wayne, Indiana, manufacturers of oil storage systems. Mr. Hyndman takes the place of the late William A. Pitcher, who met his death last May in the Aveline Hotel fire at Fort Wayne. Mr. Hyndman's experience and extensive acquaintance among railroad men will no doubt serve him well in his new capacity.

Mr. W. L. Tracey, formerly division master mechanic of the Louisville & Nashville at South Louisville, Ky., has been appointed assistant superintendent of machinery of the Missouri Pacific, with headquarters at Kansas City, Mo.

Mr. James M. Campbell has been appointed superintendent of the repair department of the Birmingham & Gulf Railway & Navigation Company, and Mr. E. B. Kirkbride has resigned as commercial agent of that company, at Mobile, Ala.

Mr. George Wagstaff, formerly supervisor of boilers on the New York Central Lines, resigned a short time ago to accept a position with the Locomotive Appliances Co. and not with the Railway Materials Company as stated in a previous issue.

Mr. A. H. Gairns, formerly master mechanic on the Denver and Rio Grande at Salt Lake, has been appointed master mechanic of the Oregon Short Line Railroad, vice Mr. H. Garrick, assigned to other duties. Mr. Gairns' headquarters are at Pocatello, Idaho.

Mr. J. J. Sullivan, master mechanic of the Louisville & Nashville at Louisville, Ky., has been transferred as master mechanic to New Decatur, Ala., vice Mr. H. C. May, who was transferred as master mechanic on the same road to Louisville.

Mr. W. J. Hoskins, for the last two years master mechanic on the Chicago Great Western Railway at Des Moines, Ia., and previously for some years on the Missouri Pacific, has been appointed master mechanic on the Chicago & Alton, with headquarters in Bloomington, Ills.

Mr. D. MacNicol, leading hand Port Arthur, Ont., shops of the Canadian Northern Ry., has been appointed locomotive foreman, on the same road at Brandon, Man., vice Mr. W. M. Armstrong, transferred.

At the recent convention in Cincinnati of the International Railroad Master Blacksmiths' Association the following gentlemen were elected officers for the ensuing year: President, Mr. J. W. Russell, Renova, Pa., P. R. R.; first vice-president, Mr. G. W. Kelly, Eliza-

beth, N. J., Cent. Ry. of N. J.; second vice-president, Mr. John Conners, Montgomery, Ala., A. & W. P. Ry.; secretary-treasurer, Mr. A. L. Woodworth, Lima, O., C., H. & D.; chemist, Mr. G. H. Williams, Boston, Mass., with B. M. Jones & Co. The president appointed the members of the executive committee as follows: Messrs. J. S. Sullivan, Penna. Lines, Columbus, O., chairman; Geo. Hartline, Collinwood, O.; M. F. Gorey, Ft. Worth, Tex.; F. F. Hoeffle, Louisville, Ky., and Thos. Keane, Hilburn, N. Y. The town of Niagara Falls, N. Y., was chosen as the place of meeting for 1909.

Mr. M. J. Powers, who for the past three years has held the position of master mechanic of the Delaware & Hudson Railroad Company's Pennsylvania Division, with office at Carbondale, resigned last May as was stated in these columns. It may truly be said that Mr. Powers' high mechanical ability and excellent method of organization have been important factors in producing the present high standard of the motive power on the division of which he had charge. By his straightforward and impartial manner of handling all matters pertaining to the working forces of the shops, Mr. Powers had endeared himself to the hearts of the many men in his charge, as was attested by the fact that on his leaving the company's service a "smoker" was given by those who had worked under him, and on that occasion he was presented with a beautiful diamond ring of no small value. Many of the most prominent residents of Carbondale participated in the presentation excercises, and all had a most enjoyable time. Mr. Powers is living in Carbondale, not having as yet looked for a position of any kind. Mr. W. J. McAndrew, formerly general foreman at the Oneonta shops of the Delaware & Hudson Company, succeeded Mr. Powers.

From Fireman to Millionaire.

By Angus Sinclair.

The old readers of Railway and Locomotive Engineering will remember the McGrane locomotive clocks and watches and not a few of them still carry McGrane watches in their pockets, timepieces that came to them through the publicity facilities of Locomotive Engineering. All the goods handled by John J. McGrane were first-class in every respect, the genuine article guaranteed by a genuine man.

One day last month as I was ascending a gang-plank at Queenstown, Ireland, on my way to the home-coming steamer, a friendly hand grasped mine and a familiar voice exclaimed: "Why, Angus, what in the world are you doing here?" On looking up I recognized the well-known face of John J. McGrane, my old-time advertiser who had along with him a party of tourists which nearly filled the whole first-class accommodation of the big Cunard steamer.

I have been well-acquainted with John J. McGrane for about twenty years, knew that he was an old locomotive engineer who had devoted his high business faculties to the building of a substantial fortune, but it was not until we were together for seven days "rocked in the cradle of the deep" that I understood the lines of endeavor worked by my friend on his upward way to fame and fortune. Our readers deserve to know how every successful man performed his better part, and the outlines of John J. McGrane's career ought to have a stimulating effect upon those beginning to climb the ladder of life.

When he was only sixteen years old, although large for his age, John J. McGrane began work as a fireman on the New York Central Railroad. At that time his greatest ambition was to become the best fireman on the road. He may not have reached the altitude aimed at in that line but he was among the best, and five years after first beginning to handle the scoop he was promoted to the position of engineer. That was sufficient glory for a short time, but by degrees the inquiry began to haunt his waking hours—how much farther up can I go on this line of occupation? The result of that mental struggle was that John quit the locomotive for a time and accepted a position under the New York City government. That did not turn out as fancy painted. There was more unrequited toil and jars in the position than had been calculated upon, and he left it to run an engine on the New York Elevated Railroads. While there his natural bent for mercantile business asserted itself and he began working up a trade in selling railroad clocks and watches. As the business was well-managed by personal industry, fair dealing and push Mr. McGrane soon found that it demanded the whole of his time, so he abandoned railroading for good.

As the clock and watch business was not sufficient to exhaust the stupendous native energies of Mr. McGrane, he proceeded to devote attention to real estate in the neighborhood of his home in Long Island City. By degrees he acquired possession of a large tract of land on Long Island which was increased in value by the new bridges and tunnel so that he was lately able to sell to the Pennsylvania Railroad Company for yards facilities, property that constituted a substantial fortune.

The occupation mentioned did not, however, fill up the measure of Mr. McGrane's capacity for work. He had found that many visitors to Europe went there through very unsystematic methods, rambling about, spending much money and receiving very unsatisfactory returns. He resolved to undertake a business of personally conducted tours through Europe and made a great success of the enterprise. He was finishing his last tour when we met at Queenstown, and intends leaving that business to be cared for by his sons.

That tour was representative of previous systematic outings. On July 16 the party left New York on a steamer specially chartered for Naples. On landing there and doing the city the tourists were taken by special trains through Italy, Switzerland, Germany, Holland, Belgium, France, Great Britain and Ireland. Stops were made at all the places of interest worth visiting, and the crowd of people ended their rambling enthusiastically delighted with the pleasure of the protracted tour.

But the party did not confine themselves to mere talk. At a mass meeting resolutions were passed praising Mr. McGrane for the admirable manner in which he had provided for the comfort of the party, and a magnificent loving cup was presented as a substantial token of appreciation.

Friends who are able to judge the value of Mr. McGrane's property assert that he has the right to be ranked among our self-made millionaires and that there are no tainted titles among his holdings. His success in life is a triumph of energy and fair dealing. Any of our readers who possess the natural ability displayed by John J. Grane have the capital on which a fortune may be reared.

Obituary.

The death last month of Frank P. Sargent, Commissioner of Immigration in the Department of Labor at Washington, removes from the service of the people a zealous and efficient officer. He was born in East Orange, Vt., on November 18, 1854. He attended school in his native village in the winter months, working on a farm in the summer. For a few years the boy worked in the Kinney Mills, near Montpelier. He afterward spent a year at the old academy in Northfield, and, when seventeen years old, went to New Hampshire, where he became a messenger in the Manchester Mills.

Railroading then attracted him, and he entered the service of the Southern Pacific Railway Company at Tucson, Ariz., as an engine wiper. Within six months he became a locomotive fireman, and within one year he was admitted to membership in the Brotherhood of Locomotive Firemen, now called the Brotherhood of Locomotive Firemen and Enginemen. He was initiated in Lodge No. 94 in an improvised lodge room, which really was a coal bin near the Tuscon roundhouse.

In a short time he became financier of

the local lodge, and he there displayed that capacity for executive detail which afterward enabled him to fill the chair of Grand Master. In 1882 he attended the national convention of the Brotherhood of Locomotive Firemen, and at its next annual meeting, in Denver, Col., he was made Vice-Grand Master. In 1885 he was elected to the office of Grand Master of the order. The keynote of his success as a labor leader and of his selection as Commissioner-General of Immigration was that he studied both the demands of the workingman and the counter contentions of the employers and decided definitely and clearly what, in his judgment, would be a fair solution of the difficulty, and then worked indefatigably to secure such a settlement. Fairness of labor to capital was Frank P. Sargent's fundamental rule of action. Mr. Sargent has always been a strong conserving influence. He never spoke in the language of the agitator, whose catch phrases he abhorred and condemned. He led the way in teaching organized labor to regard contracts made with employers as sacred and binding. He has argued that the rights of employers were to be respected, and that thus workingmen would gain more surely the recognition of their own rights. On April 4, 1902, President Roosevelt appointed Mr. Sargent to the office of Commissioner-General of Immigration, which was accepted, and he assumed the duties of that office July 1, 1902. He was a thirty second degree Mason and a member of the National Civic Federation. He also was a member of the Creve Cœur Club of Peoria, Ill., and of the Fifty Club of Philadelphia.

Harris Tabor, founder of the Tabor Manufacturing Company, and for recent years acting in the capacity of its consulting engineer, died in Philadelphia in the latter part of last July.

Mr. Tabor's death is attributed to the result of an automobile accident with which he met on Christmas day more than a year ago while driving along a narrow hillside road in New Jersey. Although he had sustained serious injuries at the time, yet later he appeared to show gradual improvement, however, until, during March, he contracted a cold which in his weakened condition became a serious illness and resulted in his death.

Mr. Tabor was born in Clarence, N. Y., January 26, 1843. Here he received a common school education and at an early age showed signs of rare mechanical and inventive ability. He was of a studious disposition, and gave promise of exceptional attainments.

On May 16, 1861, at the age of 18, he enlisted in the Twenty-third Regiment of New York Volunteer Infantry for a term of two years, at the end of which period he was honorably discharged.

Two years previous to his enlistment he began his mechanical training as an apprentice in the shop of his brother, Mr. Leroy Tabor, Sr., at Tioga, Pa. After his discharge from the army Harris Tabor entered the employ of S. Payne, at Troy, Pa., as a machinist. His next position was with B. W. Payne & Sons, Corning, N. Y., and on the removal of this concern to Elmira he was made superintendent. He was for a year at Hartford, Conn., acting as superintendent of the Hartford Steam Engine Company, and later he went to Pittsburgh to accept a similar position with the Westinghouse Machine Company. He remained about three years with this company.

So far Mr. Tabor's work had been confined to steam engineering, and he had invented and placed on the market a steam engine indicator and a throttle governor. While with the Westinghouse Machine Co. he conceived the idea of a power operable molding machine, which came to him as a result of observations he had

Harris Tabor.

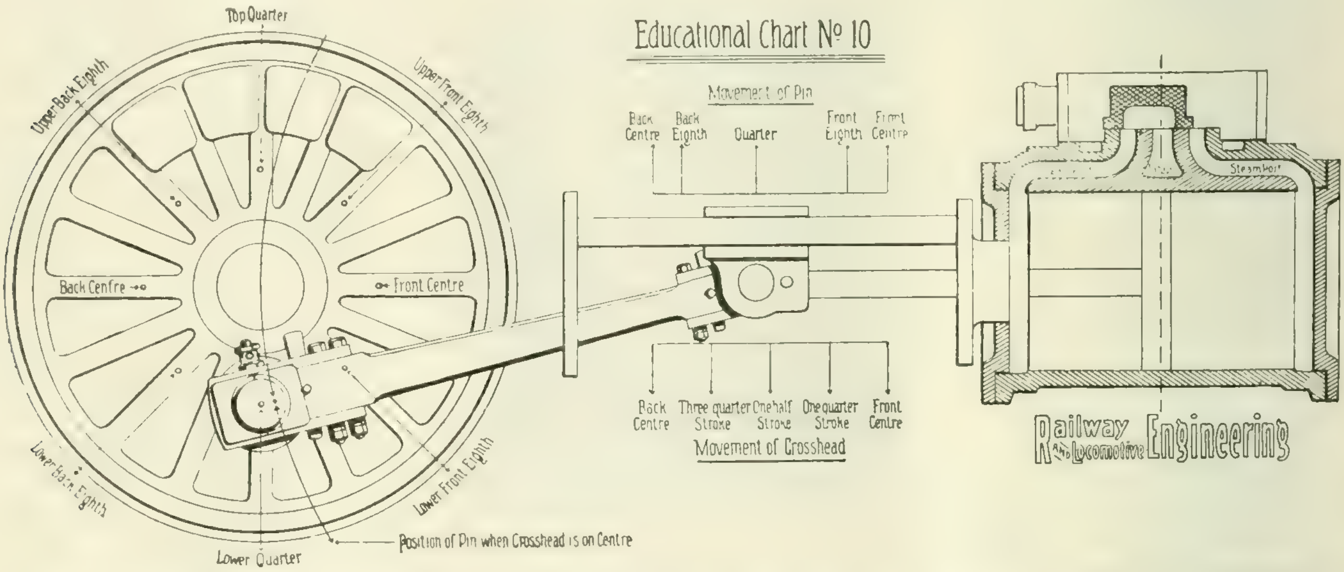
been making in the foundry. In order to carry on this work he associated himself with Messrs. Manning, Maxwell & Moore, under an agreement which provided for their assistance in developing, perfecting and marketing these machines, and he moved to New York so that he might give his entire attention to the development of his molding machine. For three years from 1885 he experimented with and built molding machines, and in 1888 produced and placed on the market the first successful power molding machine, operated by steam, with a cylinder overhead. In 1888 the manufacture of the machine was taken up by the Pond Tool Works of Plainfield, N. J., and in the early 90s the Tabor Manufacturing Company was organized and transferred the manufacture of the machines to S. F. Moore Sons Company, Elizabeth, N. J. It was here that the vibrator molding machine was brought out and the first molding machine operated by compressed air produced.

In 1900 Mr. Tabor sold the greater portion of his interest in the company to Mr. Wilfred Lewis, and the manufacture of these machines was transferred to Philadelphia. From 1900 to 1906 Mr. Tabor was engaged in looking after various interests and acting as consulting engineer to his company, having relinquished the presidency on the disposal of his larger holdings. In 1906 he took up residence in Philadelphia, and from then on to the time of his death took an active interest in the affairs of his company. Through the courtesy of the *American Machinist* the half tone illustration, which is an excellent likeness of Mr. Tabor, is reproduced.

Last July among our items of personal interest we had occasion to mention the resignation of Adam Bardsley from the position of master mechanic of the Gulf & Ship Island Railway at Gulfport, Miss. Subsequently we received a letter from the general superintendent of the road who intimated to us that failing health had compelled the retirement of a faithful and valued officer. In our August issue we referred to the sincere regret thus expressed and which was felt by the officials of the road at the retirement of so valued and skilful a man. Mr. Bardsley retired to Bradford, Pa., where he died a short time after, at the age of 60. He was a native of Kendall, England, where he was born in February, 1848. From his early years, Mr. Bardsley was identified with railroads as an expert mechanic. At the age of 17 years he left England and was engaged in railroad work in Egypt, at Alexandria, Cairo and Suez. He returned to England, and after visiting Continental countries came to the United States, settling in Vermont. From there he went to Pittsburgh and subsequently to Minnesota, where he remained for about 20 years, being master mechanic on the Northern Pacific Railroad. He came to Bradford in the fall of 1893 and became master mechanic of the Buffalo, Rochester and Pittsburgh Railroad. This position he held for a number of years, after which he became a traveling representative for the American Locomotive works at Dunkirk. When Captain Jones of Buffalo opened the Gulf road, Mr. Bardsley was given the position of master mechanic of the Gulf and Ship Island Railroad, with headquarters in Gulfport. This position he held until he was obliged to resign owing to ill health. He was a man of most excellent qualities and was held in high esteem by those who knew him.

R. & L. E. NEW EDUCATIONAL CHART NO. 10

In announcing the publication of our Educational Chart No. 10, we would state that this chart affords at once the clearest and best form of instruction in regard to many of the most interesting problems relative to valve motion and the action of steam in the cylinders. The piston, piston rod and cross head, as well as the slide valve are made of celluloid and are mounted upon superfine card board and are movable in slots in the card. On the back of the card there is a description of the causes that lead to the variations in the travel of the cross head caused by the angular advance of the main rod and its peculiar effect on the piston and valve. In addition to this explanation there are a series of thirty six questions to be answered, by placing the valve and piston in various positions. These exercises embody the Traveling Engineer's examination questions. A careful study of these questions will prepare any intelligent railway man for any kind of examination that may arise in regard to the chief features of the locomotive engine. The answers to these thirty-six questions will be given in a comprehensive and consecutive series beginning with the issue of January, 1909.



FAC-SIMILE OF OUR EDUCATIONAL CHART No. 10. THE PISTON AND VALVE ARE CELLULOID AND ARE REMOVABLE.

FREE TO SUBSCRIBERS.

This chart is offered free to all new subscribers, as well as to all who are already subscribers and who renew their subscriptions for RAILWAY AND LOCOMOTIVE ENGINEERING for one year in advance. The chart is not for sale and will not likely be for sale for some time. The demand for copies has already far exceeded our expectations. The chart bids fair to outrank in popular favor any of our previous publications offered as premiums to paid-up subscribers. The demand for copies is a strong proof of the growing desire for educational publications among railway men, and our paper is within easy reach of the humblest, as well as the highest man in the railway service.

EDUCATIONAL MEDIUM

The regular readers of our illustrated monthly periodical are furnished at once with the cheapest and best medium calculated to meet the mental requirements of all engaged in the construction, repair and running of the mechanical appliances used on railways. The hundreds of warm testimonials that come to us every year tell the eloquent story of grateful recognition of the success of our efforts. The claim that promotion in railway service has come to thousands of our readers because of the valuable information they have gathered from our pages is not made by us. It is made by men high in the railway service, and we are morally bound to believe them, and their words of praise is the highest and best kind of encouragement to us in the educational field that we have chosen.

CONTRIBUTORS.

From among the two thousand railway officials, whose names are on our lists of subscribers, many are regular contributors to our columns, and the record of their experiences adds much that is of real value to our readers. Among the other twenty thousand readers, whose work is more immediately of a manual kind, there are many who also contribute their experiences, and it is agreeably surprising to note with what clearness of thought and felicity of expression their welcome letters are written. Our pages are open alike to the highest and the humblest.

EUROPEAN EDITION.

Of late years RAILWAY AND LOCOMOTIVE ENGINEERING has found a wider field in foreign countries, and already many hundreds of the leading railway officials in Europe are among our regular readers. In brief, wherever railway men are engaged, the brightest and the best among them are our readers and our friends. It is our aim to meet their expectations and to keep in the forefront in the matter of giving the best expression to the best thoughts of the railway men of our time.

OUR ILLUSTRATIONS.

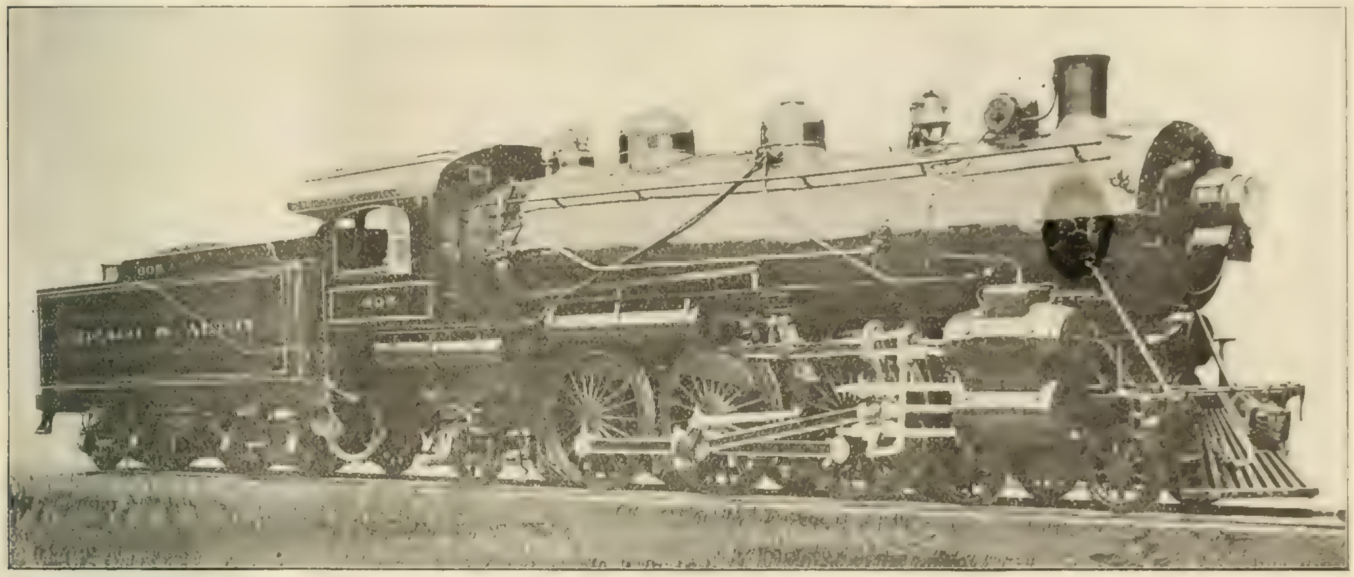
Our illustrations are generally conceded to be the best of their kind published. Details of the latest work of the chief locomotive constructors, as well as the work of the skilled mechanics engaged in perfecting shop tools and general appliances, are given with a degree of clearness that could not be surpassed. Interesting railway scenes, pictures of locomotive and other appliances typical of varied services, past and present, and not only is there made a careful selection of all that is new in the mechanical railway service, but a select presentation of all that is interesting in the past forms a new and ever-changing panorama of railway experience, at once instructive and entertaining.

OUR DEPARTMENTS.

Our departments are intended as it were to specialize or focus the view on various particulars connected with the mechanical world. Our air-brake department is one of our oldest and best known and appreciated features. The electrical department is up to date on matters connected with this new and interesting field. The patent office department is at once a valuable record and a condensed reference guide to the work of inventors of railroad appliances. The personal items, the society column, as it were, of RAILWAY AND LOCOMOTLVE ENGINEERING are always of interest, and it has been, and is, our pleasure to record the promotions of men whom hard work and ability push to the front.

Passenger 4-6-2 for the C. & A.

The first standard gauge Pacific type locomotives built by the Baldwin Locomotive Works were completed early in 1903 for the Chicago & Alton Railroad. These engines were two in number, having driving wheels respectively 73 and 80 ins. in diameter. Otherwise they were similar throughout, with cylinders 22x28 ins. In the following year three additional Pacific type locomotives were supplied to this road by the same builders. These engines, although built, with the



FAST PASSENGER 4-6-2 FOR THE CHICAGO & ALTON.

Peter Maher, Supt. of Motive Power and Equipment. Baldwin Loco. Works, Builders.

exception of the tenders, to Associated Lines standards, were in many respects similar to those delivered in 1903. They had driving wheels 77 ins. in diameter, and the same-sized cylinders as the previous locomotives.

The Baldwin Locomotive Works have recently completed five additional Pacific type locomotives for the Chicago & Alton, the design being shown in our halftone illustration. The principal differences between these locomotives and those above referred to, lie in the use, on the new engines, of Walschaerts valve-gear and wagon-top boilers with narrow fireboxes. This form of firebox was applied to a number of Atlantic type locomotives built for the same road by the Baldwin Locomotive Works in 1906.

The new locomotives have cylinders 23x28 ins. With 73-in. driving-wheels and a steam pressure of 200 lbs. the tractive force exerted is 34,500 lbs. The cylinders are spaced 90 ins. between centers, while the piston valves, which are 16 ins. in diameter, are 98 ins. between centers. The maximum width over the assembled cylinder castings is 10 ft. 2 ins. The saddle is comparatively low, and the castings are securely fastened together by double rows of bolts in the vertical flanges and two heavy tie bolts 2¼ ins. in diameter, enlarged to 2½ ins. at the threaded ends. The piston valves have cast-iron bodies and L-shaped packing rings, and the drifting valves are of Pennsylvania Railroad style with flat plates over the relief ports. Vacuum relief valves are placed in the live steam passages, and a safety valve, set for 225 pounds pressure is screwed into each cylinder head. The cylinder heads are of cast steel, and the steam-chest heads of cast iron.

The frames, where they are secured to the cylinders, are in the form of single rails 5 ins. wide by 10 ins. deep, and each cylinder casting is secured to its corresponding frame by nine horizontal bolts, 1½ ins. in diameter, and four vertical studs, 1¼ ins. in diameter. The cylinders are keyed at the front only. The frames are of forged iron, and are continuous from the front bumper to a point back of the rear driving pedestals, where they are spliced to the rear sections. The main frames are 5 ins. wide, while the rear sections are in the form of slabs, 2½ ins. wide. The splice between the main and rear frames is secured by 20 bolts, 1⅛ ins. in diameter, and by two keys which are driven, with their tapered faces in contact, into a single key way having parallel sides. The pedestal binders are of cast steel, and are lugged and bolted to the pedestal. Substantial transverse frame bracing is provided in these locomotives. In addition to a cast steel footplate at each end, cross ties of the same material are placed back of the cylinders; between the first and second pairs of driving-wheels; above the main driving pedestals; and in front of the firebox.

The valve gear details include built-up links, having side plates and end-filling blocks of cast steel. Each link is supported by two longitudinal cast steel bearers. These are bolted in front to the guide yoke and at the back to a cross tie, which also serves to support the reverse shaft bearings. The valve stems are driven by crossheads which are mounted on suitable guides. The valves are set with a maximum travel of 6 ins. and a constant lead of ¼ of an inch. The stem lap is 1 in. and the exhaust clearance 1/16 in.

The leading truck is of the usual swing-bolster type with heart-shaped links. This gives three points of support. The rear truck is of the Rushton radial type with outside journals. The supplemental frames for the rear truck are bolted to steel castings which also serve as furnace bearer supports. In this way, the firebox is carried, on each side, by two sliding bearings of ample length. The rear truck is equalized with the driving-wheels in the usual manner. All the driving springs are placed over the boxes, and are mounted on cast steel saddles. The engine and tender truck wheels have cast steel spoke centers, and were made by the Standard Steel Works Co. of Philadelphia. The driving-wheel centers and boxes are also of cast steel, and the driving tires are secured by retaining rings. Greese lubrication is provided on all driving axle and crank-pin journals. The guides are of the two-bar type, of forged steel, and the crossheads are of cast steel.

As has been mentioned, the boiler is of the wagon-top type with a narrow firebox. The center line is placed 9 ft. 5 ins. above the rail, and the diameter is 72 ins. at the front end and 83 ins. at the dome ring. The longitudinal seams in the barrel have diamond welt strips inside and are on the top center line. On the dome ring the seam is welded through its

length on either side of the dome opening.

The firebox has a sloping back head and roof sheet, and is radially stayed Four rows of sling stays support the crown sheet in front, while a total of 573 flexible stays are disposed in the sides, back and throat. The crown and sides of both the inside and outside fireboxes are each made in one piece. The fire-door opening is formed by flanging both sheets outward and uniting them with a sleeve. The mud ring is of cast steel, double riveted and re-enforced in thickness at the corners. As almost the entire firebox is placed back of the driving-wheels, with the mud ring above the trailers, large curves are used in the side water legs, thus avoiding abrupt changes in direction.

The entire grate lies in one horizontal plane, and is rocked in three sections. A drop plate is provided at the back. The ash pan is of the hopper type with cast iron bottom pans. This boiler is liberally supplied with means for washing out. Five blow off cocks are provided. Two in the waist, one in each side water leg, and one in the front water leg. The safety valves are mounted on an auxiliary dome, and the whistle is screwed into the roof sheet immedately in front of the cab. The injectors are located in front of the cab, and they feed through checks placed right and left, 18 ins. back of the front tube sheet. The total heating surface is 3,927 sq. ft.

The tender is constructed in accordance with Chicago & Alton standards. The frame is built of 13 in. steel channels, and the trucks are of the arch-bar type with cast steel bolsters.

The table of dimensions shows that these high power machines are for passenger service, and as the design has been worked out in the light of experience with locomotives built some time ago.

Boiler.—Thickness of sheets [illegible] and [illegible] in.; working pressure, [illegible] pounds; fuel, soft coal; staying, radial. *Firebox.*—Material, steel; length, [illegible] ins.; width, [illegible] ins.; depth, front, 82½ ins.; depth, back, 78½ ins.; thickness of sheets, sides, ⅜ in.; thickness of sheets, back, [illegible] in.; thickness of sheets, crown, [illegible] in.; thickness of sheets, tube, [illegible] in. *Water Space.*—Front, 4½ ins.; sides, 4 ins.; back, 4 ins. *Tubes.*—Material, Iron, wire gauge, No. 12; number, 357; diameter, 2 ins.; length, 20 ft. *Heating Surface.*—Fire box, 206 sq. ft.; tubes, 3,721 sq. ft.; total, 3,927 sq. ft.; grate area, 33 sq. ft. *Driving Wheels.*—Outside diameter, 73 ins.; journals, main, [illegible] x 12 ins.; journals, others, [illegible] x 12 ins. *Engine Truck Wheels.*—Front diameter, 33 ins.; journals, [illegible] x 12 [illegible] ins.; back diameter, 42 ins.; journals, 8 x 14 ins. *Wheel Base.*—Driving, 13 ft. 9 ins.; total engine, [illegible] ft. 8 ins.; total engine and tender, 65 ft. 8½ ins. *Weight*, on driving wheels, 146,500 lbs.; on truck, front, 47,600 lbs.; on truck back, 49,100 lbs.; total, engine, [illegible] lbs.; total engine and tender, about [illegible] lbs. *Tender.*—Wheels, diameter, [illegible] ins.; journals, [illegible] x 10 ins.; tank capacity, water, [illegible] gals.; tank capacity, coal, [illegible] tons; service, passenger.

The American Locomotive Company have recently received an order for two six-wheel switching locomotives for the Chicago Junction Railway, with cylinders 20x26 ins. The engines will have a total weight of 144,500 lbs.

Left Side Staybolts

The question, why do staybolts break more frequently on the left side of a locomotive than they do on the right, was topic No. 6 at the last convention of the General Foremen's Association. The paper was printed on page 307 of our July issue. Messrs. A. Bradford of the Big Four and W. H. Clough of the Erie, formed the committee which brought in the report.

Discussing the report Mr. Voges said: "I talked to our boilermaker foreman who has had quite a large experience, and I made it my business to find out if larger breakage on the left side was the case. For the past 8 months I have found 15 more on the right side of the throat sheet than on the left, and 3 more on the right side of the back end than on the left and I do not see anything in it."

Mr. Rhuark offered a reason for left side breakage when he said: "The only reason that a bolt will break more readily on the left side is due to the fact that the air pumps on a good many of our large engines are on the left side, on the fire box, and the constant jar of that air pump will naturally work something loose if there is anything that will break. We have them break on the right side when the pump is there. About five months ago we had an engine in the shop. We removed 6 bolts from the left side; she made 62 miles and came back with 4 more broken staybolts on the left side. We renewed these and she went out again to Wheeling and when she got back to the shop she had 18 more broken on the left side. We began to make an investigation and knocked down 117 bolts on the left side that were broken. We sent the engine to the back shop and before they got done with her they had 378 bolts out of the left side of the engine and 16 out of the right. That was something very unusual but it was due to the fact that she had an old fire box that had been running a long time."

Mr. Kelly remarked: "I see no reason why they should break more on one side than on the other. I took this subject in to the boiler maker and asked his opinion on it and he said in his experience he found no reason why staybolts should break oftener on one side than on the other, and that they didn't in his cases. There is one reason and that is that the fire box may not be spaced properly. On one side you have a greater space than on the other. The fire box had been put in wrong and not spaced right, and we had a good deal of trouble with staybolts breaking there, due to about 2 ins. difference in the length of the staybolt and the expansion caused the breakage. When the boss boilermaker found it out he knocked all the staybolts out."

Mr. Ball said: "I do not seen any reason

why there should be more broken on one side than on the other. I take it from the list given in the paper which has been read, that the engines are all of the same class, and I think it is due to some particular design in that boiler that is causing the trouble."

Mr. Kidneigh, referring to the flexible bolt, said: "We have found that the Flexible staybolt does not break off on the outside, consequently the removal of the cap would not do any good except with the hammer test. Of course when they break off on the inside of the sheet you discover them the same as any other bolt. They break next to the sheet."

Mr. Zincan said, a former speaker is ready to go to a lot of labor in removing the air pump. I cannot agree with him. To counteract this strain what must we do? We admit air to the outside sheet. If I am not mistaken 90 per cent of the locomotives in the United States today have little or no jacketing against the boiler. We have seen them standing just so to get air in. If the sheet under the air pump is allowed to become cooled off and the one on the outside still remains hot, why should there not be a difference. If we have a little leak in our air pump that helps the matter along. So far as the pound of the pump is concerned, I think that has very little to do with the breaking of the staybolts. In my experience we have more broken staybolts under the running board than we have above it, along about on the fire line. From the running board down the fire box is left unjacketed and the cold air strikes it. What do you think the leg of this boiler is going to do with the air right against it? Is it any wonder that staybolts break when we stop to consider these things. They will break under the running board where the firebox is exposed quicker than they will above. The cool sheet under the pump allows contraction and I believe that breaks more staybolts on the left side.

Mr. Kidneigh here remarked: "I would like to say that we find there are more broken in the two top rows in the Ogee bend than anywhere else and that is covered with asbestos lagging, I understand."

President Fay in concluding the discussion said: "Some one has spoken about the expansion of the fire sheet. What becomes of that expansion? In a series of tests which have recently been conducted on prominent railroads, they have attached plungers, one on the throat sheet and one on the other end. When the engine was cold they marked on the piston and when the engine was fired up that mark was identically where it was when she was cold. What became of the expansion? It could not crush the staybolt. The only thing it could do was to bulge the back end and that did not occur. But they did find that the contour of the fire sheet was corrugated. In a series of tests in England they spent three months on this one thing and did not arrive at any definite reason why it should be so or what became of that expansion."

The discussion of this important topic, which we have outlined above, taken in connection with the remarks on Staybolt Breakage, by Mr. F. P. Roesch of the Southern Railway, given on page 360 of our August paper, makes very instructive reading. The more light that can be thrown on the staybolt question, the better it will be, and the more men who think seriously over the problem and are willing to let others have the benefit of their experience, the sooner we will arrive at the real causes and get to the remedies for the trouble. The columns of this paper are open to the further discussion of this subject by anyone who has something practical to offer.

Uselessly Good.

When one speaks of a person as being uselessly good, one is apt to think that the individual described is too good or too righteous to be of any serious account in the world. These terms, however, must be taken separately and, as a case in point, which those in a railway repair shop will readily understand, take a twist drill with the tang broken off. The drill is good as far as being able to bore a hole through metal but it is bad or, more correctly, it is useless if you think of it only with the broken tang. It is an exasperating state of affairs for the reason that the drill is uselessly good.

There is, however, a way of making such a drill or reamer all right and that is to secure a socket made by the American Specialty Company of Chicago, and you will find that this socket is made outside like the original tang of a drill and inside it is hollow and fits over the broken tang if you just do one thing. Grind a flat surface on the tang. This flat surface fits along another flat surface left in the socket. This is what the socket drives the drill by, and the grinding of the flat on the broken tang is a simple operation. The two flats are equivalent to a key in both and the socket fits over a tang like an extinguisher on a candle, and the useless but good drill becomes a hard-working member of society again. When you put the socket on it extinguishes your drill troubles. When you write for a circular on this subject address the letter or postcard to the American Specialty Company, 1440 Monadnock Building, Chicago, and call the socket a "Use-Em-Up," and the company will understand you and give you all the information you want as they invented the name and the socket.

Making and Repairing Frames.

A very interesting paper on the making and repairing of locomotive frames was presented by Mr. A. W. McCaslin of the Pittsburgh & Lake Erie Railroad, at the recent convention of the International Railway Master Blacksmiths' Association held in Cincinnati. A summary of the paper is briefly as follows:

We repair some of the engine frames, as many others do at this time, without removing them from the engine, and we have very good results in the heating, and as far as the appearance of the completed job superficially would indicate. I do not say that we weld these frames, for I do not consider such an operation made without a lap of some kind deserving of the name weld: in fact, this butting of frames is simply a burlesque on proper welding. I have satisfied myself as to the virtue of this so-called weld by making several in shop, granting them many advantages that cannot be offered on an engine and invariably they would separate, showing very little resistance from a light blow crosswise the weld under a small steam hammer; the breaks would show that a union of the metal had been effected but would also show a very feeble tenacity, yet knowing these facts we are very much in favor of repairing frames this way wherever it is possible to spread the frames and take the heat, as it frequently keeps the engine in service until it comes for general repairs, and this means quite a saving in money to our companies.

We have what we think splendid burners and build a very satisfactory furnace with standard size fire brick. Mr. Shoenberger, foreman blacksmith in the Ft. Wayne shops in Pittsburgh, kindly furnished me the original design for both of them. I build the furnace with the bottom inclined, making it about one inch lower at its center than at the fuel holes at the ends; have also added a small slag hole at the center near the bottom so the slag will not gather and be blown up against the frame; we use two burners to this furnace and use crude and carbon oil as fuel, and take a very slow heat. The bottom inclined as mentioned helps to prevent the wasting of bottom side of the frame and gives the heat a start to return over the top of the frame and out the peep holes. When the heat is complete the furnace is pushed away into the pit and the work completed with light sledges with side V-welds. I do not approve of making the side V under a heavy steam hammer without using a channel tool; I do approve of making this weld under a light steam hammer or with heavy sledges.

When making this weld under a heavy steam hammer the laid-in pieces travel or flow both ways from its center crosswise the frame without interfering or resistance and does not spread enough with its angles to increase the lap, or weld properly against the wall of the V cut in the frame; that is, it cannot weld properly while flowing in a direction paralleling the walls of the V in the frame. This laid-in piece will travel along the bulk of the frame, preventing the walls of the V-cavity following. If cut off the ends of this weld, it will appear all right; the drag of the iron being just sufficient to hide the weld and the iron in the piece laid in will not be compact near its end; neither will the weld near its end be meshed to a sufficient depth. This will be entirely different as well as a satisfactory piece of work if done under a small steam hammer with light blows or with heavy sledges. In this case the laid-in piece should be properly made and the over-hang not cut too close to the frame; then side heats drawn well up to the front of the V-piece and this stock driven back into the weld, and at the same time form a lap where it is so much needed, that is, at the end of this weld on top and bottom of frame back.

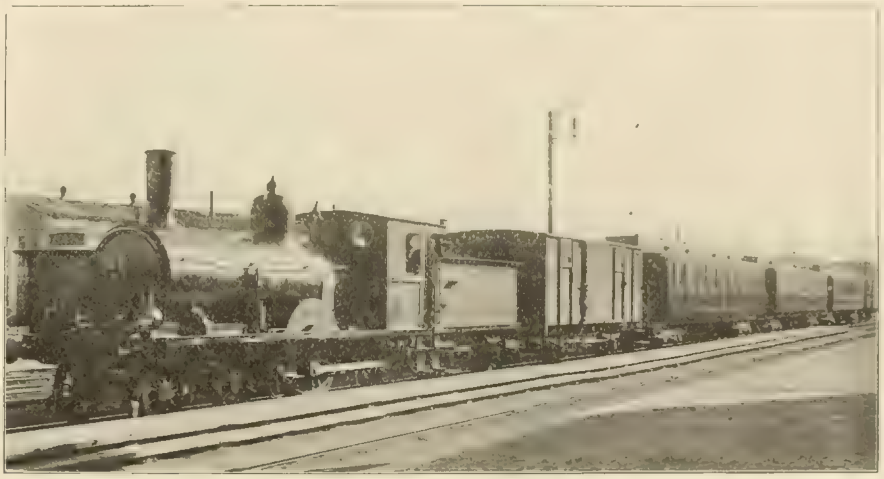
Again, if the side V-weld is made in the frame under a heavy steam hammer there should be a heavy channel tool placed on top. This tool, if 8 ins. wide, cut out $2\frac{1}{2}$ ins. deep, and half inch longer in the crown and three-quarters longer at the mouth than the cross-section of the frame, that it may release readily, will shear off the extra stock, prevent the laid-in piece from lengthening endwise and will drive it back into the weld, thus forcing it against the wall of the V, and lengthen the lap lengthwise of the frame. Then take a second heat on the laps. There will be no holes or openings at the points of this weld. This is not only the most convenient weld to make in repairing frames but it is the best. I certainly agree with Mr. Uren that the lap weld is the best weld made, but it is very seldom we can make this weld in new or repaired frames.

We sometimes make in front sections of frames and large hammered piston rods what we call a lap and V-weld. We flatten the end of each piece nearly one-third, make the lap and weld, then drive back the ends of the laps and lay in V, which insures a solid center and a solid side opposite each V. This throws the laid-in pieces about 6 ins. apart. This weld will elongate evenly when being reduced and will not slip or shear as the ordinary lap or V weld. In my opinion the end V is the worst weld made unless separate heats are taken and the parts put together with a heavy ram and a second heat taken on the laps. It takes time to prepare this weld. The parts are often placed together in the fire, but I never could

quite understand why some prefer drawing a heat through a five-inch square bar than to heat to the center from one side with the advantage of seeing heat that enters into the center of the side V-weld, with the uncertainty of the end V-welds being welded at all in the center, its liability to contain dirt, and its general successful disposition to separate at the point of the V. This weld I avoid when it cannot be rammed or forced together.

Glasgow Engine in Sweden.

Our illustration shows a 4-4-0, on the Stockholm-Westras-Bergslayens Railway of Sweden. The engine was built in Glasgow, and has cylinders 16x24 ins.; driving wheels 5 ft. 7½ ins., and carries 170 lbs. steam pressure. According to our method of calculating the tractive effort of an engine, this machine can develop a starting power of between 13,000 and 14,000 lbs. The heating surface is 1,032 sq. ft. in all, of which the tubes give 943 and the firebox contribute 89 sq. ft.



4-4-0 PASSENGER ENGINE AND TRAIN IN SWEDEN.

Home and Distant Signals in Denmark.

According to the Bulletin of the International Railway Congress Association, a white light is never used on Danish railways for giving a signal to a train, as white lights are used on roadways and in dwellings near the track and the probability of colored lights being used in the neighborhood of railway tracks is very remote. The caution color is a shade intermediate between yellow and orange to which the name "Brandgult" has been applied. This color has the advantage of being visible at a much greater distance than either red or green.

The home signal of the Danish system has two signals on the same post arranged in the same way that the home and distant signals are in America, and on the Danish lines, the double blades on the home signal indicate whether the entrance to the block is to be at full speed or reduced speed or stop. So far this is in accordance with our own railway practice, but under the Danish system the "caution" indication at the entrance to the block does not necessarily indicate the condition of the next signal ahead.

Under the Danish system when "line clear" is intended it is shown by the oblique position of both arms, and at night two green lights are visible. The stop position is indicated by both arms being horizontal and at night a red light on top and a brandgult light below. The "caution" or entrance to the block at reduced speed is shown by the upper arm being oblique and the lower one horizontal, and at night a green upper light and a brandgult light below.

In this way when a train is approaching a block the brandgult light, if shown, is seen before the upper light becomes visible and when thus seen alone, caution is inculcated because on nearer approach the signal may be found to indicate "entrance at reduced speed" or "stop," but never line clear. Where a distant signal is used, it is placed on a separate and lower post and has one arm, which, if horizontal, or, at night, showing a brandgult light, indicates the stop position of the home signal. If the home signal is at "line clear" or "caution" the distant is in the oblique position with green light at night. In this way the distant signal prepares for the observation of the home by indicating directly its stop position, but in the oblique position, with green lights, it does not distinguish between the "entrance at reduced speed" and the "line clear." In other words, the distant gives the "stop" and the "proceed" of the home, but leaves the home signal to tell its own story as to whether the proceed is to be at reduced or full speed.

I do the very best I know how—the very best I can; and I mean to keep doing so until the end. If the end brings me out all right, what is said against me won't amount to anything. If the end brings me out wrong, ten angels swearing I was right would make no difference.—*Abraham Lincoln.*

Work of the Road Foreman

Among the excellent papers presented, what might be called a very personal and appropriate paper was read at the recent Traveling Engineers' Convention in Detroit. It was on the subject: "How the Road Foreman of Engines Can Assist in Increasing Net Earnings." A brief summary of what was said will be of interest. The paper was read by Mr. James McManamy, road foreman of engines on the Pere Marquette Railway, chairman of the committee.

"The road foreman of engines occupies in reality an important position in the railroad organization, for there is probably no one element which enters more largely into the railroad's cost of producing what it has to sell, viz., the transportation of freight and passengers, than the movement of trains; and the cost of moving passengers per mile or the thousand tons of freight per mile is affected largely by the manner in which the power is handled, and it is largely the duty of the road foreman of engines to get out of the power the possible one hundred per cent. of its revenue capacity. It is generally conceded that a freight locomotive should make an average of not less than 30,000 miles per year. We will assume that the average freight carload is twenty tons per car. Let us consider the net result to the railroad if through the careful guidance of the road foreman of engines one additional car can be added to the train. This would increase the tonnage revenue of the locomotive 600,000 tons one mile per year, and assuming the average returns to the railroad to be one-half of one cent per mile, we have increased the revenue of each locomotive $300 per year.

"'Can't' is the unfortunate attitude of thought held by a large number of men, and all of us have met in our experience this ready 'can't' each time we have presented to others some such possibility as above stated. In writing the preceding sentence I have not overlooked the fact that on some lines the tonnage question has been carried to an extreme, and that the power has been so completely overloaded that in the effort to move tonnage the reverse condition has resulted, and unfortunately on those lines two extremities have met with disastrous results to the net earnings of the railroads. One side has insisted upon the enforcement of the exaggerated idea of tonnage per train, with the result that trains actually spend more time on sidings than is required to cover the distance between terminals, and at the same time those trains consumed more time waiting for orders than the actual running time required between the terminals. In other words, more time is lost on sidings and waiting for orders twice over than is required to cover the distance between terminals, and I question the economy of such operations. But I do not justify the attitude of the other extremist who always insists upon 'can't' and therefore does everything in his power to defeat the other plan by increasing the delays above stated.

"In all of my railroad service, I have insisted that there is only one department on a railroad, and that is the department of profit or loss, and it is therefore the sole duty of every officer of the railroad to let the idea of increased net profits be the mainspring of each act as relates to railroad operation. Therefore, there should be no opposing influence between those connected with the motive power and those who are giving their undivided time and attention to the matter of transportation. There should be no conflict between those at the head of the motive power and those at the heel of transportation. There should be a close co-operation between the road foreman of engines, train masters and train despatchers, and each should be perfectly willing at any and all times to set aside his personal opinions in deference to those of the other in an earnest effort to bring out the highest possible good for the railroad as a whole. This statement applies to every person in the employ of the railroad from the highest to the lowest, and working along these lines I do not hesitate to say that there are thousands of locomotives in service to-day that will easily handle one more car per train than they are hauling now on an average year in and year out, and if properly kept moving will handle one train more each month instead of consuming this time on side tracks. Despatch is just as valuable to the shipper as a lower freight rate, and he will always patronize the road that delivers the goods to him with the least delay.

The road foreman of engines and those whom he represents can do a great deal toward drawing the line of consistency between prudence on one hand and overloading the locomotive on the other, and in this way will be able to get the locomotives over the road with less delay and get them into terminals where they can receive proper attention in the way of necessary work and with very little delay have them ready for another successful trip, all of which proves economical in the cost of maintenance and fuel and will enable you to greatly increase the miles per locomotive in your charge.

"This means more tons of freight over the road in a given time with the same number of locomotives, and less cost per ton mile. Nothing requires more careful thought and closer co-operation between the road foreman of engines and the transportation department than this one question. By taking hold of this problem with a determination to improve conditions, you can do a great deal toward solving the transportation problem and increasing the net earnings of the railroad. The road foreman of engines can

do a great deal to reduce the cost of production or increase the net earnings by properly educating the men under him.

"The factor of safety is of the first and greatest importance and requires constant vigilance on the part of all concerned to avoid accident to passengers and employees and damage to property; next in order of importance is economy in the use of fuel, oil and all supplies. This requires close co-operation between the road foreman of engines and the engineers and firemen and close attention to the making of steam and then avoiding its waste. The engine must be properly drafted, so it will steam well. Brick arches must be cleaned off and flues kept clean. Keep all leaks out of the fire box and plug up every other leak around the engine. I might add here that many road foremen of engines would be surprised if they knew the actual loss by leakage on the locomotive; in other words, the surplus steam the locomotive has to make in order to have the amount necessary to do the work. The outside machinery will ordinarily be inspected. The valves, cylinder packing, front end, flues and firebox do not always get tested or examined until trouble of a serious nature exists. An engine with badly worn machinery that has a good boiler and uses the steam without leaks will handle a train fairly well, although it may take a little more coal. Yet the coal is doing the business because it is getting the train over the road, while the same engine with the ordinary leaks would burn more coal and not come near doing the work. In other words, any engine with the boiler kept in good steaming condition and without leaks will after the first three-months' service out of the shop begin to increase its superiority over its sister engine that is cared for as many locomotives are cared for to-day, and it will increase its superiority day by day as the time out of the shop grows longer until finally when they go to the shop the first one will still be able to do pretty fair work while the other will be, in common language, 'ready for the scrap pile.'"

In the report of the Master Mechanics' committee that tested slide and piston valves for leakage in 1904, the following conditions are shown:

The best piston valves tested leaked 268 lbs. per hour and the worst tested at a mileage of 36,000 leaked 2,880 lbs. per hour.

The best slide valves tested at a mileage of 17,500 miles leaked 384 lbs. per hour and the worst tested at a mileage of 39,000 miles leaked 2,610 lbs. per hour.

LEAKAGE IN LBS. OF WATER PER HOUR.

	Least.	Greatest.	Average.
Piston valves, 14 engines	268	2,880	[illegible]
Slide valves, 11 engines	384	2,610	[illegible]
Average leakage, all valves, 25 engines....	...	....	[illegible]

Average loss in coal for each engine per day, month and year, in both freight and passenger service, averaged at ten hours per day, evaporation figured at 7 lbs. of water to 1 lb. of coal. The figures are:

One Day.	One Month.	One Year.
[illegible]	[illegible]	[illegible]

Average loss in dollars and cents per engine per day, month and year, coal figured at $1.50 per ton.

One Day.	One Month.	One Year.
[illegible]	[illegible]	[illegible]

"The tests were made on two different railroads and with great care. The leakage was calculated by condensing the leakage steam and measuring it in pounds of water; the common snap-ring piston valve and the strip partially-balanced slide valve were the ones tested. Multiply these figures by the number of engines in your service and the result gives food for reflection. Note the mileage at which this appalling waste occurs. Then, if you can, just imagine or estimate the amount of this waste during the time and at which time the engine reaches a satisfactory mileage or period of service, it will give you a fair estimate of the amount of steam and fuel wasted on account of steam leaks in valves and cylinder packing of the average locomotive."

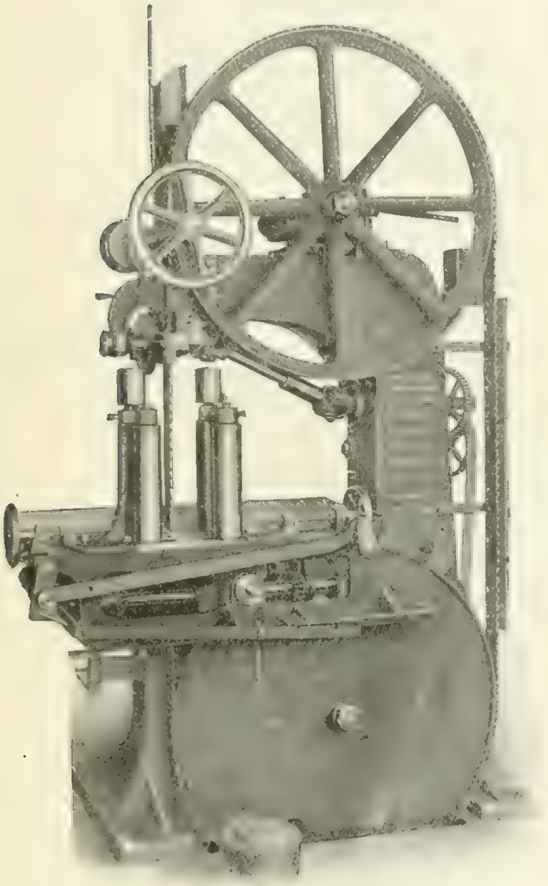
The Daylight Saving Bill, as it is usually called in Great Britain, is a measure which has received the approval of the committee of the House of Commons which has had the matter in hand. It is probable that next April the clocks in the United Kingdom will be officially set "fast," so that although work and business will begin earlier than if regulated by "sun time" so much more daylight will be secured after hours in which the workingman will be able to take his recreation. Although this arrangement is new on the other side of the Atlantic there is at least one instance in which "daylight saving" has been resorted to by a well-known manufacturing concern in America. We understand that for a number of years the Joseph Dixon Crucible Company, of Jersey City, at their graphite mines at Ticonderoga, N. Y., have had the clock at that place set ahead one-half hour so that the workmen may have more daylight for work in their gardens or for recreation and rest.

We are informed that the Mobile & Ohio Railroad recently purchased one of the Twentieth Century Outfits made by the Buker & Carr Manufacturing Company of Rochester, N. Y. This machine, as many of our readers know, is for handling airbrake hose, and that it is able to perform four distinct operations with minimum change and is at all times easy to operate. What it does is to mount new hose, pull off old, cut clamp bolts, and cut hose to proper length. The rapidity with which hose work can be done on this machine is surprising. The purchasing agent of the M. & O. reports that the machine is giving entire satisfaction.

Band Rip and Resaw.

A very ingenious tool, and a practical and economical one, is the Combination Rip and Resaw made by the J. A. Fay & Egan Co. of Cincinnati, O. This machine is useful in shops that do both ripping and resawing but have not enough of each to keep separate machines busy.

Our illustration gives a good idea of the machine when ready to resaw. The front part of the table, which carries the resaw rolls, can be quickly reversed, thus converting it into a rip saw or visa versa, as occasion requires. The table is made in two parts, mounted on a rocker bearing, which permits it to be placed at an angle



BAND RIP AND RESAW.

of 15 degs. for bevel siding. The feed rolls for ripping are placed as close together as possible, so that short pieces can be fed in without difficulty. The machine will rip work measuring 24 ins. wide and 18 ins. thick. The resaw rolls are self-centering and will open to saw to the center of 8 ins.

The machine is equipped with the company's patent sensitive straining device, which permits running the blade at about twice the usual speed without danger of breaking. Interested readers can obtain further details by addressing the manufacturers.

Standard Office Supplies.

The Pennsylvania Railroad have lately made some curtailment in office expenses, not by discharging men, or by paying them less than formerly, but by reducing the waste of what is used in their offices. Expenses, even in small things, are being cut closely, but without sacrificing actual needs. No article in the way of office supplies is so insignificant as to escape consideration. This applies to rubber bands, pens, ink and pencils and stationery.

It was found that rubber bands cost annually a very large sum of money, and this expense has been very materially reduced. Instead of every clerk having a box of each size, an assortment of bands is supplied, office supplies are being standardized, such as lead pencils, erasers, pens, paper tablets, letter heads and all printed forms, and less expensive paper is being used for stationery.

This form of retrenchment, which is in the hands of a committee, is one that can only meet with approval all over the road as it is simply applying the legitimate principle of stopping the leaks and practising economy where necessary without hampering the employee in the discharge of his duties.

A very artistic catalogue, dealing with the important matter of packing, has lately been received at this office. It is issued by the Revere Rubber Company, of Boston, Mass. The advancement made by modern steam engineering has increased temperatures and pressures to a point where non-combustible material is a necessity in many cases. To meet this condition the Revere Company has placed on the market a number of asbestos packings and gaskets which are all illustrated and described in the catalogue, which, though of convenient size, contains 60 pages. The effect which special heat resisting lubricants have upon packing have been considered in the manufacture of their products. In this catalogue there are various forms and sizes enumerated and their extent and variety is such as to meet all requirements in railway as well as stationary and marine work. A copy of their catalogue will be sent free to anyone who writes to the Revere Rubber Company for a copy.

Independent Audit.

The Canadian Pacific Railway Company, the strongest financial institution in Canada, in order to conform to a practice that is becoming quite general on this continent, and is universal in Europe, had its last annual report, the balance sheet and accounts, examined and certified by Messrs. Price, Waterhouse & Co., one of the most reputable firms of English chartered accountants. The financial

See page 452, this issue

statement of the company for the year ended June 30, 1908, is therefore not only vouched for by Mr. I. G. Ogden, third vice-president, as in the past, but is attested by the following auditor's certificate: "We have examined the books and records of the Canadian Pacific Railway Company for the fiscal year ending June 30, 1908, and having compared the annexed balance sheet and income account therewith, we certify that, in our opinion, the balance sheet is properly drawn up so as to show the true financial position of the company at that date, and that the relative income account for the year is correct."—*Montreal Witness.*

Technical education in the sense of a full college course is not available for everybody, and for the man who is already engaged in work it is impossible. To meet the demand for instruction in the various branches of engineering, Columbia University offers at night during the year 1908-09 twenty evening courses specially adapted to the needs of technical and professional workers. This includes work in applied mechanics, applied physics, architecture, electricity, fine arts, industrial chemistry, mathematics, and surveying and structures. The work begins on October 26, and continues for twenty-five weeks. A full description of the courses may be obtained on application to the Director of Extension Teaching, Columbia University, New York.

The American Locomotive Company have just issued their report for the year ending June 30, 1908, and it is very gratifying to observe that in spite of the general business depression the company's works have all been kept at nearly their full capacity. The falling off in the demand for locomotives for American service has been almost made up by the increased foreign business, a large number of locomotives having been exported to Japan, Corea, China, Europe and South America. The development of business in Canada has also been very satisfactory.

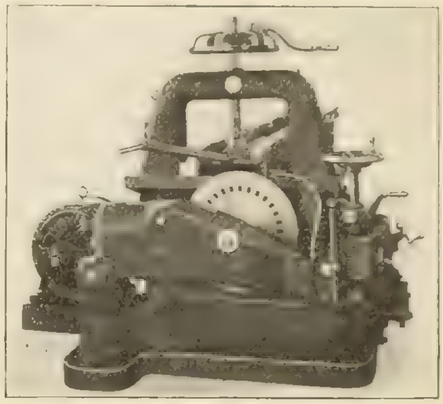
We understand that the business of The Dukesmith School of Air Brakes has grown considerably during the past year, and that larger offices are now required in which to conduct the business. They have therefore moved their headquarters to Meadville, Pa., the original home of the school. Owing to the many recent changes made in the air brake art, it was found necessary to add a great deal of matter to the course of instruction and to entirely rewrite the text book used by the school for its students. The school offers a very practical course of instruction for railway men and others.

Motor Driven Cold Saw.

In the average machine shop one or more saws are required [illegible] more or less [illegible] place for mechanical drive. Here the use of a small motor on the [illegible] permits the location to be selected without reference to any requirement except the convenience of getting work through. The self-contained unit of motor and saw can be picked up by a crane and carried to any part of the building or yard, if necessary.

The cold saw which we illustrate is one that does not use a bevel gear. The saw is made by the [illegible] Equipment Co., and is fitted with a Westinghouse shunt motor. The size shown requires a 2 [illegible] H. P. motor and is capable of cutting 8-inch round stock. A Morse silent chain is used to connect the motor to the saw, in preference to gearing, as experiments have shown the former to be more satisfactory.

It is necessary to be able to adjust the speed of the saw in order to cut



MOTOR DRIVEN COLD SAW.

different metals with maximum efficiency. For instance, experiment has shown that the peripheral speed of the saw should be 52 ft. per minute with a very coarse feed for structural iron, machinery steel and metals of that class. For annealed tool steel a lower speed of but 37 ft. a minute is the most efficient. This same speed is also used on Krupp's chrome nickel steel. In order to obtain these speeds, an adjustable speed motor with speed range of 1 1-3 to 1 is used, with a speed controlling rheostat. It is only necessary to move the handle of the controller to obtain any desired speed.

The Bettendorf Axle Company of Davenport, Iowa, secured a new factory site several years ago which enabled them to manufacture all classes of railway equipment, including the building of complete railway cars. This concern has come rapidly to the fore in recent years and their large plant, situated at Bettendorf, a suburb of Davenport, is being constantly ex-

tended and increasingly provided with improved machinery. This company have now over half a million bolsters in service and the Bettendorf car truck with the "one-piece" frame is growing in favor with the railway systems of the country. At the present time an order for 2,500 steel underframes for the Chicago, Milwaukee & St. Paul Railway is being turned out at the rate of about 25 a day.

Sir George Barclay Bruce.

One of the last of the early railway pioneers has died, in the person of Sir George Barclay Bruce, whose death occurred last month at London, in his eighty-sixth year. He learned engineering under Robert Stephenson. One of his first works was the construction of the railway bridge crossing the River Tweed at Berwick. This bridge is 2,160 ft. in length and 126 ft. in height. He was five years in India engaged in railway construction. Returning to London he became consulting engineer on many European and South American railways. He was present at the opening of the Northern Pacific Railway and represented the Institution of Civil Engineers. He was a man of distinguished and commanding appearance, a general favorite among all classes, an accomplished engineer, an able writer, a ready and eloquent speaker, a genial gentleman. He always claimed that men were more difficult to engineer than matter. He was the first British official who succeeded in getting a fair day's work out of the natives of Hindustan. They were formerly impressed into service. Mr. Bruce had the faculty of transforming them into contented workers. He was a great and good man, much esteemed and much honored during his later years.

CONTENTS

Railway and Locomotive Engineering

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A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXI. 114 Liberty Street, New York, November, 1908 No. 11

Luxurious Travel on Erie.

By Angus Sinclair.

A few weeks ago I was called to Chicago to one of those events where railroad men constitute the speakers and the audience, the kind of meeting that an observer can see and hear many things that the ordinary stay-at-home person likes to read about. In considering the means of transportation I decided to take train No. 3 of the Erie, known as the Vestibuled Limited—illustrated in the accompanying engraving. My experience with quite a number of trains on the Erie in the succeeding three weeks gave me the impression that all the through passenger trains on that road are vestibuled, but that does not detract from the comfort of the Vestibuled Limited.

Everything else being equal I prefer the Erie to any other route, probably because it was the first railroad that carried me to the hopeful West and led me towards the spot where my labors entitled me to consider myself one of the country's producers and an humble member of the American railroad fraternity.

A well-founded boast of the promoters of the Vestibuled Limited is, that the train is one of the most luxurious means of transportation to be found in this or any other country. The dictionary has been ransacked for words to describe the luxurious character of this train, but words fail to do justice to the conditions, these must be enjoyed to be thoroughly appreciated. The most comfortable hotel to be found is what this train aspires to and meets in every particular.

THE FAMOUS "VESTIBULED LIMITED" ON THE ERIE RAILROAD.
(*Photographed by Mr. F. W. Blauvelt, New York.*)

My recent trip on this train naturally sent my mind back to the conditions of travel that prevailed when I made my

first journey over the road, some thirty-five years ago; it also set me reflecting upon the growth of luxurious accommodations in traveling and the incessant demand for more comfort that has come with every contribution to ease and refinement. To sit all night cramped up in a jolting, stuffy stage coach was the common lot of traveling humanity little more than half a century ago, and no bitter complaints were heard about discomforts that were considered inevitable. It was only when railroads began to provide real comforts that the taste for luxuries began to arise. Think of the time when the chief engineer of the longest railroad in the United States recommended that passenger cars should have springs under them. When the germ of the modern car (entered at the end) was introduced into New England, a demand arose for the cars being lighted at night. The superintendent in charge granted the use of a single candle and on request being made that a candle be placed at each end of the car he returned a very gruff refusal saying that it was impossible to satisfy some people.

In 1838 a crude form of sleeping car was placed upon the line between Baltimore and Philadelphia, but it was operated only about three months, when the new contribution to comfort was withdrawn for want of patronage. Some twelve or fifteen years later a newspaper writer said: "I ran across an early sleeper somewhere in the Blue Ridge Mountains in South West Virginia. It was low and narrow and dark and stuffy. It wobbled and creaked and jolted and jumped in all directions like a boat in a choppy sea. It had little windows that you could look out of only by bending double, and a narrow passage walled in by iron rods, one reaching to the roof from the back of every seat. On these rods the upper berths were hitched till nearly bed time. The lower berths were narrow and so short that you had to lie in one like a half-opened jack knife, with your knees in the air and the bed clothes pushed up like a tent. You did not need to be pious in order to thank heaven when you got out of that car."

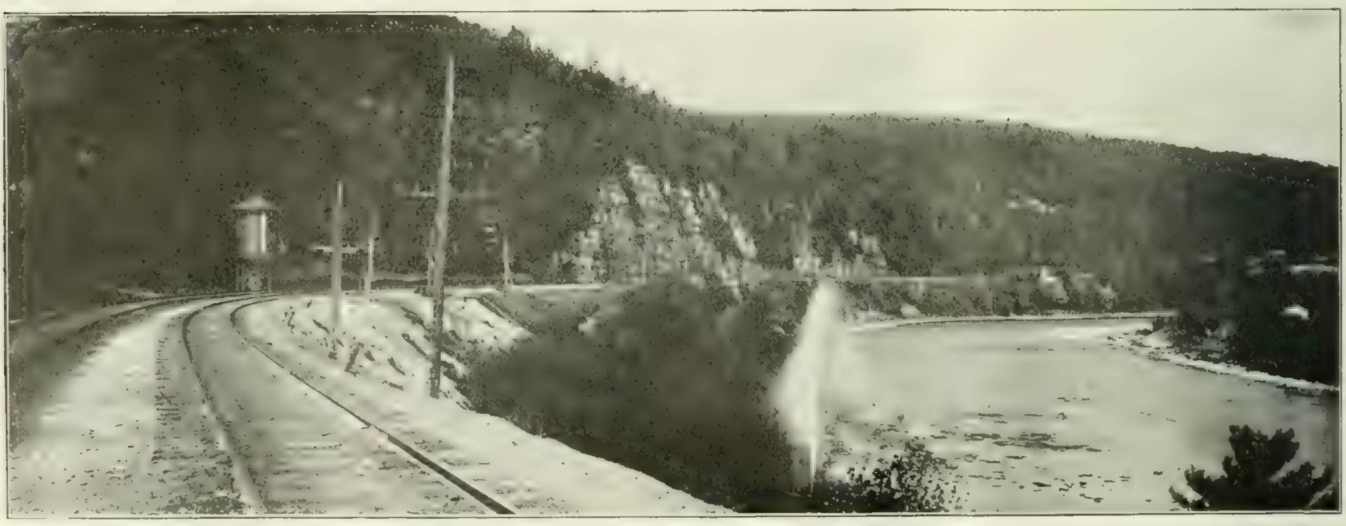
STARRUCCA VIADUCT NEAR SUSQUEHANNA, PA., ERIE RAILROAD. OLDEST PIECE OF RAILROAD MASONRY IN THE UNITED STATES.

For many years a plain pine board was considered a soft enough seat for railroad cars, and cushions were provided reluctantly. A New England molder of public opinion is on record as saying:

"There were no soft, effeminate cushions in those grand old days; no cunningly contrived easements to back, body and legs were imposed upon the passenger to rob him of his manliness and his energy and his powers of resistance. Everything was constructed upon heroic principles; everything was so ordered that death, at any time likely, and at all times probably, was robbed of half its terrors and oftentimes looked upon with complacency, if not with longing."

On the failure of the early attempts to introduce comparative luxury into railroad travel, modern conditions forced their way upon railroad companies, thanks to George M. Pullman and others who had never been satisfied with anything short of perfection.

I have dwelt upon the luxurious side of travel as a contrast to the conditions of my first trip on the Erie. At that time the use of sleeping cars had not come to be regarded as a necessity to the extent it is now. The demand in that respect much resembles what it is in Great Britain to-day. When I was making inquiries about a sleeping car from London to Manchester in August last, a good-natured recipient of one of my tips assured me that no person used sleeping



VIEW ALONG THE ERIE RAILROAD, NEAR PARKER'S GLEN, PA.

carriages except dooks, doods and Yankees.

An extract from my note-book made many years ago gives a very faithful description of the conditions of night travel about the time I first made acquaintance with American railway trains. The story reads:

"At Port Jervis a six-foot-and-a-half lumberman enters a day car and prepares to make himself comfortable. Takes off his boots and rests his feet upon his bag to keep them off the floor. After a brief trial finds his knees in the way and slides them up to the top of the seat in front. Body and legs now form an inverted N and he falls asleep, when the conductor rouses him half an hour later to ask for his ticket. He imagines that his neck is broken, but it has only got the cramps. He decides to try another plan, so he takes his bag to use as a pillow. As he lays his cheek upon it he finds that the bag has picked up from the floor an abandoned chew. He says —— —— —— two or three times and then he takes out his knife and scrapes off the tobacco and after that he lies down and stretches his legs over into the aisles. Comfort at last he grunts, and has just fallen asleep when a man comes along to take a drink and calls upon him to take his legs out of the passage. He holds them in a perpendicular position like the roller lift span of the Alton bridge at Chicago, until the man gets through going and returning. Again he goes to sleep and has hardly begun to snore when another passenger demands the right of way to the water cooler. By the time that eleven others have taken their turn and the trainmen have claimed the right of way seventeen times, he decides that it is better to sit up. After a time he prevails upon the brakeman to turn the back of the seat next to his which was empty. Taking his bag for a pillow he curls himself into an irregular U and occupies both seats. He is now comfortable and dreams that he is visiting Florida, but presently the scene changes to the Arctic regions and he imagines himself searching for the North Pole and awakening with a start he finds that the passenger who went out at Corning had forgotten to close the door and a zero wind is blowing in at forty miles an hour. He blesses the careless passenger as lumbermen bless, prepares to warm up with a drink, but finds that his bottle has got broken and he remarks again —— —— —— and walks in the aisle to renew his circulation. By the time he reaches Jamestown he has made up his mind to adopt in future the practice of patronizing sleepers or walking."

LONG EDDY, N. Y., ON THE DELAWARE RIVER, ERIE RAILROAD.

HORSESHOE BEND IN THE DELAWARE RIVER, ERIE RAILROAD.

But we in the Vestibuled Limited are spinning through space under very different influences from those around the overgrown lumberman. From the start we are traversing scenery of a majestic and striking character, with which few countries out of Switzerland can make even comparison. Forest, stream and mountain make up combinations of scenic beauty that delight the artist eye and move the most prosaic imagination to admiration.

The scenes that delight the eye begin to appear as soon as the train passes out of the station at Jersey City, and the attractions are so numerous throughout the whole journey that the observation car is constantly crowded with people eager to enjoy the scenes presented to their eyes with ever-varying plentitude. The engineers who surveyed and located the first railroad between the ocean and the lakes made numerous blunders that were expensive to the stock holders, for they who located the original line [illegible] in working the line through regions where there always was something worth seeing. The banks of streams were favorite locations and the road is almost constantly following some famous river or the head waters of one known to the whole world.

When the Erie was first opened to Dunkirk in 1851 its future as a prosperous enterprise reposed more upon hope than upon faith. It traversed a country rich in natural resources, a land that would flow with milk and honey as soon as the cows and the bees were in evidence, but they had not come yet and there was little to haul except some lumber and the enterprising settler going West. It was no wonder that the company supped sorrow and other forms of hard fare for many years. But the conditions that every company [illegible] came in course of time. [illegible] crossings grew into villages and towns sprung up in numerous places where the raw materials for manufacturers were found in abundance or where Nature's power invited the wheels of industry. To-

GATEWAY, TUXEDO PARK.

day the Erie Railroad from New York to Chicago presents throughout the long route a string of golden beads in the form of prosperous cities, towns and villages nearly every mile, showing some jewel, priceless after its own kind. To repeat the words of a speaker at the last Erie Club's banquet: "The old Erie is getting there and don't you forget it."

Smoke Preventing—Jim Skeevers and the Fourth Vice Try Experiments.

By John A. Hill.

There is going to be a reform on Jim Skeevers' road about smoke making, or smoke preventing. We know there is going to be a reform because the fourth vice-president says there is, and he knows.

The Fourth Vice has read three scientific books on combustion, and all by his lone self wrote out a bulletin notice about preventing smoke, that showed he was master of the subject. When the boys consulted the bulletin board one morning they read the following: Official Order, No. 39. (The Fourth Vice was educated at West Point and married the president's daughter.)

OFFICIAL ORDER, NO. 39.

The careless habit of enginemen in allowing black smoke to issue from their engines must be discontinued from this date. By firing in such a way as to distribute the carbon evenly on the grates and admitting about four-fifths of the total volume of air to the ash-pan and one-fifth above the fire, the oxygen and hydrogen will mix and all smoke will be consumed before reaching the flues, thereby abating a nuisance and showing a great economy in fuel. Controllable air jets will be put on all passenger engines at once; but men on freight can prevent smoke by putting their fire door on the first notch of the latch for one and a half minutes after each new supply of fuel, then closing it. When the engine is standing, open fire door and put on the blower slightly.

The penalty for a disregard of this rule will be instant dismissal from the service.

John Massey, Gen. M. M.
Approved, A Verry Newe,
Fourth Vice-President.

Of course, all the boys knew that the Old Man, John Massey, was never guilty of writing anything about oxygen and hydrogen, and that he knew too well how heavy the trains were and how much coal they had to burn per hour; then, years ago, the Old Man fired and run, and he would just as soon expect the men to obey an order to hold their left hands on the seat of their pants when passing all mile-posts as to half close the fire door for one and a half minutes after each fire.

Skeevers pulls the express freight. It's heavy, the time is lively, and the "93" never was known to go over the road without burning coal; never was known to burn much coal without some smoke; never was known to steam any too well with the fire door shut, and never was known to steam at all with it half open.

Skeevers determined to work in an object lesson on the man that wrote that bulletin. (Skeevers' specialty is object lessons.)

Skeevers went home and put on his store clothes and presented himself at the office of A. Verry Newe, fourth vice-president.

He worked his way past the outside guard, made the grand hailing sign of distress before the altar of the "assistant to" and was permitted to send in his name and business on a little piece of paper. He wrote:

"Skeevers, engineer '93'; come to get help and advice about smoke-prevention."

He was admitted to the holy of holies, salaamed before the Fourth Vice, hung his hat on his left thumb, and said:

"Mr. Newe, I am very much interested in smoke prevention. I think it can be entirely stopped if the men are instructed right. Now, what I called for is this: I think if you can get one engine to run without smoke you can make the other crews do as her crew does, and the job is complete; it would take two years to instruct all the men on the road. Now, I want the honor of having the first smokeless engine. You know that my train—the express freight—is considered of the most importance on the road. You sidetrack passenger trains for it every day. Now, I thought I could get you to put on some old clothes and go out with us this afternoon. You know more about smoke-prevention than anyone else because you have made a study of it (the Fourth Vice smiled here and stroked his mustache approvingly). The signals are so thick and the importance of time so great that I cannot watch the fireman and give him the right instruction; but if you would sit on his seat for half a trip and tell him when to shut the door and when to leave it on the latch and prevent him from using too much coal at a time, I think the '93' would throw no smoke and be an example to all the rest."

The Fourth Vice agreed to Skeevers' plan, and Skeevers went home with a pay-day smile on his phiz.

That afternoon as the "93" backed down on to her train, A. Verry Newe, fourth vice-president, stepped upon her hurricane deck, and Skeevers introduced him to the fireman, Pete Doyle.

"Mr. Newe; my fireman, Mr. Doyle. Pete, Mr. Newe is going over the road with us to give us a few pointers on smoke preventing. You fire just as he tells you; I am anxious that the '93' should be the first to run without smoke."

Pete said "All right, sorr," but there was a sneer under the coal dust as he glanced at the "dood collar" and effeminate face of the Fourth Vice.

The Fourth Vice got a clean piece of waste to wipe his hands, and looked around nervously. He had never been on an engine before with any responsibility at all.

Skeevers oiled around, and then shut himself upon his side of the boiler—the "93" was a mogul—and said to Mr. Newe:

"I shan't be able to notice you much, as it keeps me pretty busy with the signals and all; but Pete will do just what you tell him, and I am sure we shall learn something before we get over the road. But here's the orders. Are you all right, Pete? Well, we're off."

The "93" picked up her twenty-four loads and started out of the yard.

"Phwat about the firin', sorr?" asked Pete of the Fourth Vice.

"Well, fire lightly, and don't close the door at first."

"Shall Oi putt in a foire now?"

"Well, yes, I suppose so; fire about as often as you do regularly."

Pete jumped for the shovel and fired in three or four scoops of fine coal; the black smoke rolled the second the door closed; the Fourth Vice glanced at the stack and spoke sharply to Pete:

"Open that door on the latch, sir; don't you see how the smoke is coming out?"

Pete opened it, waited a couple of minutes, then the Fourth Vice motioned with his hand to have it shut.

"That's the way to do it, my man; do you see there was no smoke at all?"

"Oi do, sorr, but she dropped foive pounds of stheam, do ye moind, and it's harder to git than to lose."

There was just the trace of a wrinkle on the brow of the Fourth Vice, as he glanced at the gauge.

"Shall Oi putt in another foire, sorr?"

"Yes, if it's time."

Pete chucked in three shovelfuls, well distributed, and the Fourth Vice watched the stack with joy—there was no smoke. Pete turned his shovel over and held it in the door for a second, looked up at the stack, and jumped for the tank, commencing to fire coal into the furnace like mad.

Skeevers was wrestling with the sand-lever, for the "93" was slipping.

"Stop!" shouted the Fourth Vice, "are you crazy? you put in ten shovels of coal there at once; leave that door on the latch."

"But she jerked a hole in her foire, sorr."

"How's that—a hole in her fire?"

"In course, phwen he slipped her she histed the coal off the front av her grate, the foire wor too thin."

"She didn't throw smoke until you put in the fourth or fifth shovelful."

"Oi'm onto that, sorr; phwen there wor no smoke I knowed there wor a hole, an' all the draft wor goin' in there."

Skeevers kept himself busy and apparently paid no attention to the play on the deck.

The "93" lost another 5 pounds of fog.

The Fourth Vice, Pete and Skeevers each had a wrinkle on his brow now, and Skeevers looked at his watch, then at the steam gauge anxiously, whenever the Fourth Vice looked his way. This kind of anxiety is catching.

Pete left the door on the latch one-and-a-half minutes by the watch after every fire; fired as he was told, worried to see the steam go down, sweat like a butcher and wished the Fourth Vice was in Halifax.

Skeevers kept his eagle eye on the rail and looked anxiously at his watch. Steam was down to 105 pounds, ten miles out, and at Peeksboro he was four minutes late and there was a red flag out.

"Please put Pete on to the way to use that blower and door to prevent smoke; there's an ordinance against it in this town," said Skeevers.

Skeevers went to the telegraph office for orders, and returned with this message:

"Report cause of delay to your train at once. J. E. B."

This he handed to the Fourth Vice.

"What's this for?"

"Bluff wants to know what has delayed us. We were four minutes late and he has held us six more to ask us a useless question; does it every day we get three minutes late."

"Don't pay any attention to him."

Skeevers jumped onto the engine, glanced at the gauge and said:

"Pete, why in the devil didn't you blow her up and get her hot? She ain't gained a pound."

"The gintlemon said, kape the doure open and the wind-jamber on aisy loike."

It was hard starting with 105 pounds of steam, and when they got back to speed they were fifteen minutes behind time, and had to lay back one station for the Flyer. Skeevers pretended to be mad at Pete and raved about being disgraced; never was so late before. Why in the—couldn't he keep wind on the engine?

"Is it fog yer wantin', Misthur Skeevers?"

"Yes; here's a sixteen mile hill ahead of us, thirty minutes late, and no steam."

"Well, sor, Oi can fix ye out if ye will let me foire this kittle for stheam; but Oi am foirin' her now under instructhins fur smoke, and yez can have yer chice."

"Well, get her hot anyway, now."

Pete shut the door, opened the blower wide and then fired in a half-dozen shovels of coal. She smoked, but the finger on the gauge commenced to crawl up toward a hundred and enough.

"Mr. Newe, don't you think that if we could get more oxygen to combine with the hydrogen over the fire that we could complete combustion better?" asked Skeevers.

"Well, I don't know but we could; but what we need is in"——

The Flyer went by here, and the Fourth Vice didn't finish, for the "93" was tugging at her train when the last sleeper passed. Pete and the Fourth Vice "fired her for smoke," and the "93" laid down half way up sixteen mile hill and had to be "blowed up."

At Hilltop they got another sassy message about delay of train, and at Sumerton they were an hour and five minutes behind the schedule and had delayed most of the other trains on the road—the "93" hadn't done such a thing in years.

The coal dust and sweat mixed with the wrinkles on the brow of the Fourth Vice. As they were taking water at Springvale he asked Skeevers how much steam he needed to keep the train on time.

"One hundred and sixty."

"Do you generally have it?"

"Always."

"Why don't she keep it up now?"

"Oi can give yes a straight tip on thot," said Pete, sliding into the pit.

"Well?"

"Foire her for stheam."

"Well, fire her for steam, then; we've got to get this train over the road some time," said the disgusted official.

"But she'll schmoke a little, sorr."

"Damn the smoke."

"That's what Oi say all along, sorr."

The Fourth Vice slid off and took No. 4 back to town.

Pete, the "93" and Skeevers finished the trip with 160, and, well, she did throw some smoke.

When they got home the next day there was a note for Skeevers to report to the general superintendent at once. He reported.

"Old Calamity," as the boys called the general superintendent, was in a swearing rage.

"What's the matter with your engine, Skeevers?"

"Nothing at all, sir."

"How came it, then, you lost an hour and forty minutes yesterday, missed your connection, delayed half the trains on the road and raised hell in general?"

"Experimenting to save smoke."

"What right have you got to experiment all the trains on the road late, tell me that?"

"I wasn't doing the experimenting."

"Well, who was?"

"The fourth vice-president, sir."

"What in the name of the bald-headed Abraham does he know about smoke?"

"You saw the new bulletin about it, didn't you?"

"No."

"Well, any engineer who can't burn soft coal with a forced draft at the rate of a hundred or two pounds per square foot of grate per hour without smoke is to be discharged."

"Who says so?"

"The fourth vi"——

"The fourth jackass."

"I asked him to show my fireman how to combine the hydrogen and oxide and the choloric and the carbolic and the debolic, so as to do away with smoke—and that was what was the matter with the '93' yesterday."

"She didn't steam?"

"Pete says she was fired for 'schmoke.'"

"Well, you make time, smoke or no smoke; I know you fellows make too much smoke around stations and can prevent it some; but you can't burn coal without some smoke any more than you can boil water without making steam."

"Well, what about the bulletin? There are already a lot of rules and orders in force that if obeyed would stop every train on the road. You officers know we have to disobey them to do our work, but if anything happens we were disobeying orders. Mr. Newe might just as well have ordered us to have burned no coal at all—it's one or the other, which shall it be; smoke, steam and time, or no smoke, no steam and no time?"

"That bulletin will come down and the man that put it up will take it down. I'm getting tired of this kindergarten railroading."

"What about stopping a train that is three minutes late to ask what delayed it, and give it five minutes more in the neck?"

"It's bad business; they do that on the G., M. & T."

"They do it right here."

"Who the h——"

"Read that; ask Mr. Newe, he was with us," handing him the message received about delay.

"Look here, Skeevers; you knew how this smoke business would come out, didn't you?"

"I could guess fairly well."

"What did you let this Newe go out to bother you for?"

"To teach him an object lesson."

"Well, what do you suppose he learned?"

"That you can figure out more about

smoke preventing on a mahogany desk than you can show in practice and do the work at the same time. That it would be easy enough if all you had to do was to prevent the smoke, and that there was more cry than wool in this smoke nuisance howl, anyway. That what can be done with a big stationary boiler with natural draft, burning twenty pounds of coal per square foot of grate per hour, cannot be done on a locomotive burning more than a hundred, any more than a Corliss valve gear will do on an express engine."

"Well?"

"You put up a request something like this and you will have little cause for complaint, and take down the old one."

Then Skeevers sat down and wrote out a bulletin:

"Considerable complaint comes from various towns about the throwing of heavy clouds of black smoke. The management of the road recognize the fact that the enginemen cannot burn coal without some smoke, but know that where they try, they can, in a large measure, prevent it in towns and villages by intelligent firing, the use of the door and blower.

"Away from towns smoke is of little consequence. Fire then so as to keep an even and full pressure of steam with the least fuel.

"Those firemen who are the most successful in preventing smoke at stations will be given the best engines to fire, and this record will not be forgotten when it becomes necessary to promote men.

"The company has no set rules or pet plans of firing, but leaves this to the judgment of the men on the engines; you will be judged by results, not by methods."

"Try that on 'em and see if you don't have less trouble."

"Old Calamity" put on his specs, read the order over twice and then said:

"That's worth trying, young man; it's worth trying, and damme if I don't think you'd make a pretty good railroad official yourself."

"I think so, myself," said Skeevers, "but the president has no other daughters, and I'm married, anyway."

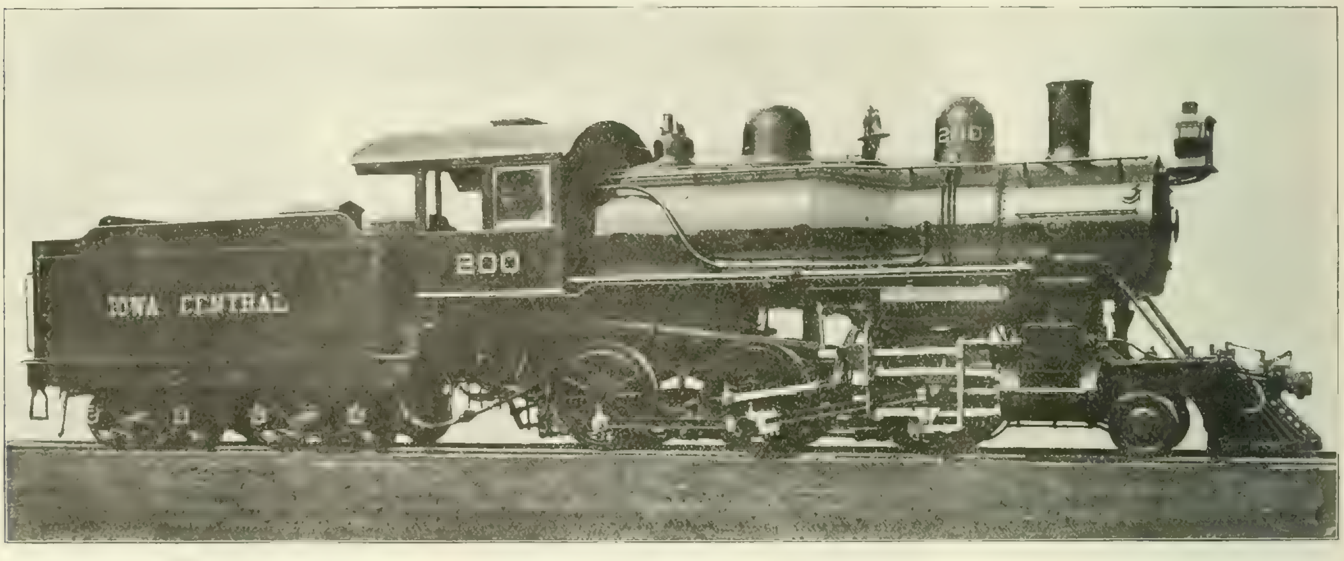
Mogul for the Iowa Central.

The Baldwin Locomtive Works have recently built six 2-6-0 type of locomotives for the Iowa Central Railway Company. These engines are designed for freight service, and can exert a tractive force of 33,400 lbs. The general plans were prepared in accordance with drawings and specifications furnished by the railway, although many of the details were designed by the builders. During recent years the Mogul type has been largely superseded by locomotives having more elaborate wheel arrangements and greater steaming capacity, in proportion to their tractive force. For general freight traffic, however, where the requirements are not too exacting, this class of engine is particularly suitable, and is still performing efficient service.

The new Iowa Central locomotives are equipped with single-expansion cylinders, 20x28 ins. The steam distribution is controlled by balanced slide valves, which are driven by the Walschaerts motion. The cylinder castings are of the usual design, except that the steam chest center lines are placed 2½ ins. outside the cylinder center lines. In addition to the usual cylinder cocks a third cock is placed on each side for the purpose of draining the live steam passages. The location of the steam chests and the spacing of the wheels on these locomotives makes possible a simple arrangement of valve motion with all moving parts practically in one plane. The link bearings are bolted to the guide yoke, which also supports the reverse shaft bearings. The valve rods are coupled directly to the combining levers, and are supported by suitable bearings which are bolted to the top guide bars. Cast steel links and return cranks are used. The valves are set with a maximum travel of 5½ ins. and a constant lead of 3/16 ins.

The driving wheels are 57 ins. in diameter, and all wheels are flanged. The driving-wheel base is 14 ft. 6 ins., and the engine base is 23 ft. The weight distribution is 128,000 lbs. on the driving wheels, 26,300 lbs. on the engine truck, which gives a total of 155,200 lbs. for the whole engine. The weight of the tender when added to that of the engine gives a grand total of 265,000 lbs. The guides are of hammered iron, case-hardened, and the guide yoke is also of hammered iron. It is made in three pieces, the bearers for the bottom guide bars being securely bolted to the yoke proper. This form of construction has been used on a number of heavy locomotives recently built by the Baldwin Locomotive Works. As is usual in locomotives of this type, the first pair of driving wheels is equalized with the engine truck, while the loads on the main and rear driving wheels are separately equalized. The truck is equipped with "Standard" forged steel wheels, with rims 3 ins. thick. Cast steel is used for the truck frame, main engine frames, driving wheel centers, driving boxes and crossheads.

The boiler is of the wagon top type, with a wide firebox having a vertical throat sheet and back head. The shell construction presents no peculiar features, but the arrangement of the tubes is somewhat unusual. As shown in our



SIMPLE 2-6-0 FOR THE IOWA CENTRAL.

[illegible] Master Mechanic. Baldwin Locomotive Works, Builders.

line engraving, the tubes are arranged in approximately vertical rows, and the horizontal spacing is uniformly increased from the top to the bottom. The same spacing is used in both the front and back tube sheets. The boiler barrel measures 64 ins. at the front end. The firebox is radially stayed, with two T-irons supporting the front end of the crown. The side water legs slope outward slightly as they rise. The mud ring is a steel casting, double riveted to the firebox shell, and supported on sliding shoes in front and a buckle plate at the rear. The shoes bear on a steel cross-tie which forms a substantial frame brace under the front end of the firebox. The heating surface is proportioned to the size of the boiler, and consists of 153 sq. ft. in the firebox, and 2,026 sq. ft. in the tubes. This makes a total of 2,179 sq. ft. The grate area is 40 sq. ft. and with reference to the heating surface is in the proportion of 1 to 54.

The construction of the tender calls for no special comment. The frame is built of 13-in. steel channels, and the trucks are of the arch-bar type with cast-steel bolsters and double elliptic springs. The tank is U-shaped, with a sloping floor in the fuel space. The tank has a capacity of 5,500 gallons and the fuel space holds 9 tons of bituminous coal.

The principal dimensions of these locomotives are given in the table and our half-tone illustration shows the general features of the design.

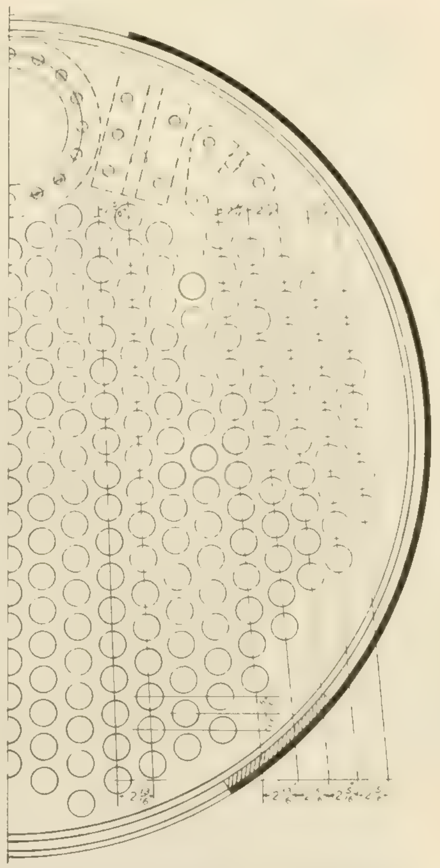
Boiler.—Material, steel; thickness of sheets, 5/8 ins., 11/16 ins., 3/4 ins.; working pressure, 200 lbs.
Firebox.—Material, steel; length, 96 ins.; width, 60 ins.; depth, front, 71 ins.; depth, back, 61½ ins.; thickness of sheets, sides, 3/8 ins.; thickness of sheets, back, 3/8 ins.; thickness of sheets, crown, 3/8 ins; thickness of sheets, tube, ½ in.
Water Space.—Front, 4 ins.; sides, 3½ ins.; back, 3½ ins.
Tubes.—Material, steel; wire gauge, No. 11; number, 318; diameter, 2 ins.; length, 12 ft. 3 ins.
Driving.—Journals, 9x12 ins.
Engine Truck Wheels.—Front diameter, 30 ins.; journals, 6x10 ins..
Wheel Base.—Driving, 14 ft. 6 ins.; total engine and tender, 50 ft.
Tender.—Wheels, diameter, 33 ins.; journals, 5x9 ins.
Service.—Freight.

Wood Preservation.

The action by the board of directors of the American Railway Engineering and Maintenance of Way Association in appointing a committee of seventeen to investigate and report upon the subject of wood preservation has shown that the practical railroad men of the country recognize the importance of taking steps to conserve the rapidly diminishing timber supply of the United States.

Timber is one of the principal materials purchased by the railroads and its economical use is a subject of far-reaching importance. More than 100,000,000 crossties are used annually by the different railroad companies, and their average life in this country is not more than six or seven years. From a study of European methods, and the knowledge of wood preservation under conditions in this country, timber testing engineers say it is reasonably certain that an average life of from 15 to 20 years may be secured by treating the tie with a good preservative and the use of improved devices for the prevention of mechanical abrasion, thus to a large degree diminishing the drain upon the timber supply.

While the quantity of timber used for ties is very great and the problem of



LAYOUT OF FLUES OF IOWA CENTRAL ENGINE, SHOWING DIVERGING CENTRE LINES.

a future supply is a serious one, yet this class of timber is not the only one which should receive consideration. A greater length of service from timber now used by railroads for bridges, trestles, piles, fences and transmission poles is greatly to be desired.

Prizes for Good Track.

The Pennsylvania Railroad has distributed a sum of money, amounting to $5,400, in the form of prizes to supervisors and assistant supervisors of track for maintaining sections of track in the best condition during the past year. Mr. W. W. Attebury, general manager, with a large party of operating officers, recently went over the road on the annual inspection, and the prizes were awarded upon the arrival of the inspection party at the end of the trip.

These awards were made upon the basis of frequent inspections during the past year by a special committee composed of Messrs. J. T. Richards, chief engineer of maintenance of way; L. R. Zollinger, engineer of maintenance of way; W. G. Coughlin, superintendent of the western division; W. L. Cooper, superintendent of the Bedford division, and C. T. Dabney, superintendent of the central division.

One of the methods used to learn the comparative excellence of the alignment and surface of the main lines was to place glasses of water on the window sills on each side of the inspection car. Every "spill" of water occurring on each supervisor's section was carefully recorded. There was also a machine on the floor of the car which recorded the jolts of the train from side to side and up and down. These records formed the basis on which the committee decided the prize awards.

To Students of Drawing.

One of the most accomplished draftsmen who ever made artistic delineations of locomotives was J. G. A. Meyer, who was for years chief draftsman of the Grant Locomotive Works. Mr. Meyer was author of several books, among them, "Easy Lessons in Mechanical Drawing and Machine Designs," a most comprehensive work that every aspirant at being a mechanical engineer ought to study with zeal and industry. The book is in two volumes, handsomely bound, and costs ten dollars, but is cheap at the money.

Some of the New England philanthropists who devoe themselves to promoting human comfort have commenced an active agitation against unnecessary noises. The particular noise they wish to suppress at present is the sound of steam exhausts that locomotives produce when starting from stations. A remedy for this would be the general use of expanding nozzles, but should railroad companies go to the expense of equipping their locomotives with this cure for noise, the use of the device would be neglected. It is a case of one person leading a horse to the watering trough and an army being unable to make him drink.

Standard Time.

Would-be Passenger (out of breath from running): "When does the half-past five train leave?"

Porter: "Five thirty."

Passenger: "Well, the town clock is 27 minutes past, the Post Office clock is 25 minutes past, and your clock is 32 minutes past. Now, which clock am I to go by?"

Porter: "Ye can go by any clock ye like, but ye can't go by the train, for it's gone."—*Birmingham Weekly Post.*

General Correspondence

Some C. & N.-W. Engines.

Editor:

I am sending you four photographs which would, no doubt, be of interest to your readers. I have numbered each one and will give you some information regarding them. No. 1 is a picture taken at the Narrows, Ableman's, Wis. from the cab window of C. & N.-W. Engine 217 going 55 miles an hour. Picture No. 2 shows the new style of C. & N.-W. smoke stack as applied to an atlantic type engine. No. 3 is a view of a 4-4-2 type locomotive No. 1080 as is also No. 4.

The views are striking and as railroad photographs may be of interest.

WALTER H. BENTLEY.

Oak Park, Ill.

Roundhouse Foremen Attention.

Editor:

In connection with roundhouse foremen, and Mr. A. H. Riddle's letter about an association of roundhouse foremen, let me say, I believe the formation of such an association to be a step in the right direction and should receive the support of every roundhouse foreman who is ambitious to become a more useful man. We can of course gain lots of information from printed articles handed out by the other associations, but our line of work, in a great many cases, is vastly different from theirs, we being "cobblers." The successful roundhouse foreman, at an outlying point, is the man who can quickly and safely cobble up a job to get the engine, with her tonnage, to the main shops for permanent repairs.

There is no limit to the amount of help we can be to each other with a journal of our own, as a medium through which we can explain our little devices for the quick despatching of power. I hope this is not the last of this talk, but would like to see it carried out.

It has been demonstrated that the other associations have been the means of saving dollars for the railroad companies and why would not ours?

A. B. GLOVER,
Roundhouse Foreman.
Pere Marquette R. R.

A Trip Over the Road.

Editor:

To begin with, a full train up a long hill with many curves. To get this train up this hill in the time allowed, locomotive boiler will leave station with what water the boiler will conveniently carry, and a good fire in the firebox.

The engineer in order to save coal runs as far as possible on the boiler

CLOSE TO THE BIG ATLANTIC, C. & N. W.

of water, and if the hill is not too long, may go to the top, and if down the opposite of this hill the train will run, the engine is shut off, the draught is gone, except very little natural. If the time will permit, and the hill enough, the injector will have the boiler full again.

Now let us take the same hill, with the same train, late, and engine is worked very hard and fast, and if the engine steams hard, due to poor coal, which may be dusty or fine, or green, the engineer has most likely to hold up steam to make his time, work his injector to lose water, and try to make up the lost time and get the water back again. Going down, the injector will be on full head most likely.

The draught, by use of the steam exhaust, in the stack, was made to do the work of a natural draught. Equal to a stack probably five hundred feet

high, say five to eight hundred or more. We had to have this strong draught, in order to burn the coal fast enough, to get heat to boil the water from low temperature. The water receiving no heat except what was put into it as it went to the boiler. This putting the water in the boiler at the low temperature, and so fast, caused the engine to burn so much coal and get the very low percentage of the heat.

Down this first hill you will strike a level track. The work then will be more steady. Yet the time is hard to make with several stops in say thirty miles. In approaching each station, the engine is shut off, injector on full head, fire door open until the fireman has put in a fresh charge of coal, frosty water going to the injector and frosty coal into the firebox.

The conductor is through at the station, a signal is given to leave, off goes the injector. It has filled or put all the water in the boiler in the time allowed. The water being cold, heat units were gobbled up faster than the steam gauge indicated. Finally after leaving the station, no water going to boiler, the fire begins to put heat units back again. Yet all this time the cut-off is long, and the steam cylinders are after your surplus water. Water or fuel should not be used unless ready to boil and burn at once. The water should not go to boiler only as it is used, and no faster.

Now let us take the same trip with the power pump driven by the motion of the engine.

On leaving the station, the speed of the engine necessarily will be slow, also the flow of water. As the speed of the engine increases, so does the draught. Speed, water and draught working in unison. The power pump will enable the engineer to heat the water before going to the boiler. This can be done with what is not thrown away. The water being heated more or less, flashes into steam sooner. The wealth of the water and coal is the heat in them. Time is what the coal needs more than anything else in delivering up its heat. All manner of heating surface will not save coal if the heat is hurried through the flues. Theoretically so many cubic feet of air is necessary to burn a pound of coal. But to burn the coal faster, almost twice as much air is used, and in doing this, holes are made in the fire-bed and much of the coal, gas and sparks are lost. But what is the engineer to do? Time is calling on the engine for more power, the cut-off is increased, the exhaust increased, and the fireman doing everything to keep coal on the grates.

Talk about expense. Is it any wonder? Trying to raise water say from 50 degrees to 387, the temperature at 200 lbs. pressure, and at the rate of a gallon a second. No wonder mud-ring staybolts flues and leaks. No wonder the side sheets crack. High and low temperature continuously. If 50 lbs. of coal can be burned an hour with 6/10 inches draught per square foot of grate surface, what are you going to do with five to ten inches of draught?

To-day we are where our forefathers first begun, as far as handling water in the locomotive boiler is concerned, except purifying the water. But it is plain to us all that heat is necessary to dissolve the encrusting matter from the water. No wonder the railway president is up against it on the fuel question. Ten million dollars ($10,000,000.) for coal, and by far the most of it wasted, for it goes out of the stack, and more yet will be, if engine is run a large number of miles each month. No time to clean firebox and bore out flues. Too hot. Men won't do good work in such places. Too much coal lost in transit. Out of the car doors, tops of tender and the gangway, and also shaken off by running fast over rough roads, which is another loss.

WM. WILEY,
Sioux City, Ia. Loco. Engineer.

VIEW TAKEN FROM THE CAB WINDOW OF A MOVING ENGINE. THE NARROWS, ABLEMAN'S, WIS.

Locomotive Repairs in Early Days.

Editor:

In the days long past on many railroads, in fact on all of them, prevailing customs left much to the individual immediately in charge for his attention and repairs that is at present handled in a more systematic, if not to say in a better, way.

With lighter locomotives and poorer track the locomotive engineer of three or four decades ago had many an interesting proposition to deal with which received successful treatment by "rough and ready" methods without ever engaging the attention of the master mechanic or the superintendent of motive power. The natural tact and resources of many of the men who were identified with early-day railroading was such as to command the respect and attention of many who stood far above the plane of manual labor. In the old by-gone days, the "link and pin" and the "non-air" era, it was indeed interesting to note the rough and ready remedy that was ever on hand for any "freak occurrence" that might develop.

The writer has often seen trainmen making a coupling when the two drawbars would not come together owing in either the horizontal or the vertical planes. For vertical adjustment of such a difficulty, it was usually only necessary to use some blocking making a sort of inclined plane which would cause the approaching car to rise sufficiently so that it would be on approximately the same level with the other car to which it was desired to couple, when a forced coupling would be brought about. If the difference in height was too great to be treated in this manner, one link would be thrust through another link, a pin stuck through for a toggle, and a short length of pin and link chain would be made in less time than it takes to tell it, the length of chain so constructed always being short enough so when the coupling was made there would be enough tension on it so that no slipping or sliding of any of its parts would ever result and thus allow the integrity of the improvised chain to be impaired. For crowding a car sideways to force a coupling the proc-

ess was slightly modified; a couple of pieces of short, stout plank, or an old tie perhaps, would be put in place so that on the high side it would rest on the rail, forming a descending slope toward the side to which the car was to be coaxed; this would generally suffice, but if the car was at all obstinate in complying with the desire of the self-made mechanic, a couple of links, well oiled, would be placed in position on the high side so that when the wheels climbed them there would be a very strong sliding tendency toward the low side, when the hitch would be made as in the first case.

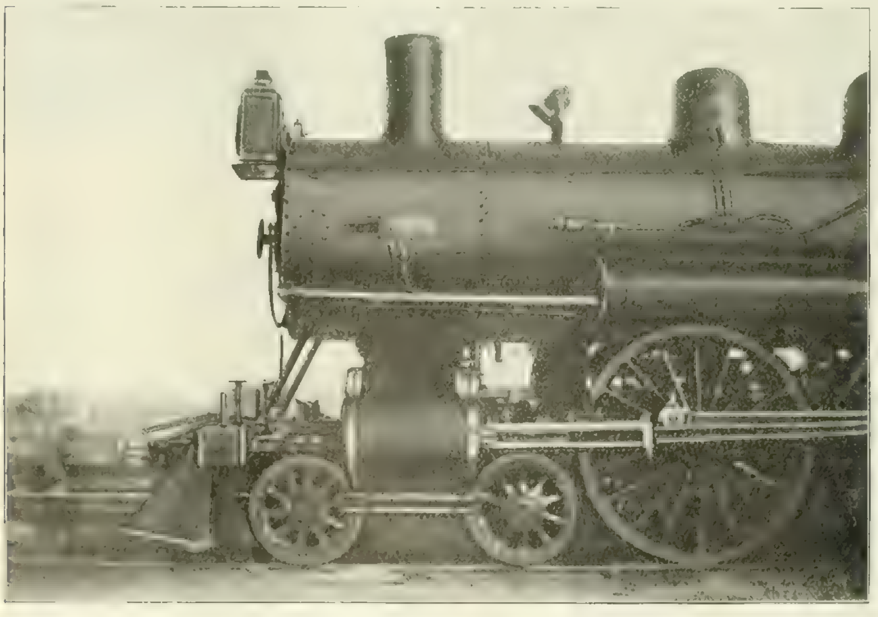
The description of couplings so far in this article may appear as a digression from the subject indicated by the heading, but as it is merely an introduction to the narration of an interesting reminiscence from real life, and further, as in the days of short trains, the engineer was never very far from the rear end, except when the train parted, the engineer was usually the master of ceremonies on such occasions, so if the matter be regarded in this way, the digression may be pardoned.

The Troy & Boston, of which it has been said never had any track at all, but only "two streaks of rust and a right of way," could probably furnish as many interesting reminiscences in regard to phenomenal speed, hairbreadth escapes and getting something out of nothing as any railroad in the country. Our narrative dates back to '72, at a time when railroading, if not in its infancy, certainly was not out of its teens, not, at least, if it is measured by development rather than by the span of years. Twelve cars of freight of the kind of cars in vogue at that time was a T. & B. big freight, and the addition of one more car meant a stall on the grade even more certainly than it would with forty cars anchored to a modern "battleship."

The engine that could handle twelve cars in good shape was the exception and not the rule and the runner that had possession of her was as satisfied with his good fortune as he was jealous of the

C. & N.-W. TYPE ENGINE.

engineer that was "pulling wires" to get her away with him. Our narrative at this point leads to the mention of a particular engine, a soft coal burner, inside connected, called the "John Paine," No. 1. Out of deference for the engineer, to whom this "good-in-its-day" locomotive passed, we will withhold his name, but as it will be necessary to refer to him frequently in what follows, he will be identified by the letters F. L. Q., and he was a born mechanic, and he had strategy in even a greater degree. Now, it happened there was quite a lot of "wire pulling" between the boys for the best engines, some of them having more "drag" with the master mechanic than others, and it was nothing uncommon when a runner that knew his business put a "bum" engine in such good shape that some other fellow was very anxious to get hold of her for his own use.



NEW STYLE OF C. & N.-W. SMOKESTACK

Anyway, this engine, the "John Paine," which none of the boys had much use for, was shifted around until it landed with F. L. Q.; he was willing to work and the rest of them were willing he should work. Somebody has remarked that the *chef* who can prepare an elaborate spread with no resources in the larder from which to draw is the fellow that has his job down pat.

This axiom seems to be particularly true as far as the improvement of the "John Paine" was concerned. The engine would not steam and could not be made to burn her coal, notwithstanding that the case had been carefully diagnosed and all kinds of treatment prescribed and administered. F. L. Q. seems to have formed the opinion that it was a throat and lung difficulty, for he devoted all his skill and knowledge to the proper adjustment of that mechanical paraphernalia known as the petticoat pipe, which acts as a policeman for sparks and cinders and which furthermore is not by any means neutral as far as its action is concerned in connection with the draft of the locomotive. The petticoats were tried first in one position and then in another, the results being watched with eager contemplation that when the proper adjustment was secured there would be very decided improvement in draft.

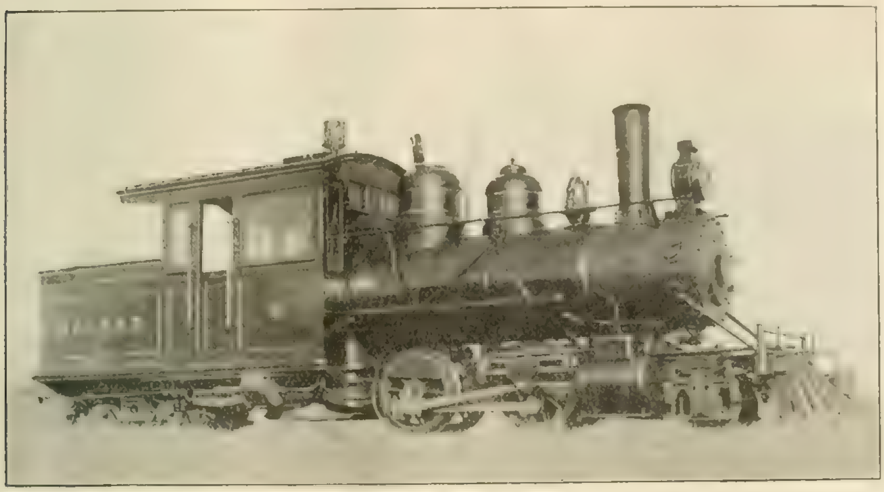
After tedious experimenting the keynote was finally struck, the draft was better than it had ever been before and the "John Paine" became really a model steamer. Honest toil always has its reward, so the poet says, and F. L. Q. scarcely had this engine up where she belonged before he had good reason to surmise that some other runner ere long would enjoy the fruits of his toil. Not being given to napping on his job, he had

taken the pains to make a memorandum of the results of the different experiments made in the front end of the "John Paine" and, further, he was in a position to put her back on original lines if it should ever serve any important purpose to do so.

Our master mechanic had a little daughter, some ten years of age, who was a great favorite with the trainmen at the terminal. She had formed a particular attachment for F. L. Q., often staying around watching him working on his engine, for he really was in a class by himself, and in such work he nearly always stayed until the others had gone. One particular evening as the train drawn by the "John Paine" pulled into the terminal the engineer received a merry greeting in a childish voice: "Ha, Mr Q., you don't know what my Pa is going to do to you to-morrow; George is going to have your engine; he is going to run that Vermont excursion. Don't say I told you!" she added, and then she disappeared, laughing merrily, as she ran toward home. F. L. Q. stayed after school that evening; he had some work of minor importance on his engine until after the rest left, then the front end was opened up; there was a change in "petticoats" and the "Paine" was herself again!

The Vermont excursion left the T. & B. terminal next morning as per programme, drawn by the engine "John Paine No. 1." No particular trouble was encountered until grades and curves near the terminus of the run were encountered, when the "John Paine" had a balky spell that would discount a dozen bucking automobiles, and although she did get back to Troy with the train and under her own steam, there really was a "pusher" in the shape of the force of gravity, it being nearly all down grade, which probably was the only thing that saved the engine "Paine" from final relegation to the scrap heap. Mr. F. L. Q. kept his smokebox notes to himself and let others do all the guessing they wanted to.

North Adams, Mass. T. H. REARDON.



NO. 6 TWO FOOT GAUGE BALDWIN ENGINE ON THE B. & S. R.

Bridgton & Saco River Railroad.

Editor:

There probably are not many readers of RAILWAY AND LOCOMOTIVE ENGINEERING who have ever been in Bridgton, Maine, though some of our best known railroad men are graduates of its famous academy, which has just celebrated its hundreth anniversary. It is also the headquarters of one of the most interesting railways in the world. The Bridgton and Saco River Railroad runs from Bridgton Junction to Harrison, a distance of twenty-one miles, and is one of the few two-foot gauge roads in existence. Bridgton Junction is a point on the White Mountain Division of the Maine Central, and the B. & S. R. is the only means of communication between Bridgton, Harrison and the outside world.

The railroad was built to Bridgton in 1882 and extended to Harrison in 1898. It does a freight and passenger business and operates all the year round the same as any road. It is controlled largely by local interests and Mr. J. A. Bennett of Bridgton is president and general manager.

I left Portland one morning, and after a pleasant ride of about one hour the train pulled into Bridgton Junction. I had never seen a 2-ft. gauge road and was naturally curious to see what one looked like. As you first get sight of the track it looks almost like a toy road, it is so narrow. In a few moments a whistle is heard and the train for Bridgton pulls in. As we started in a few moments I was obliged to wait to see the locomotive till later, but I looked over the car carefully. The passenger cars are regular little day coaches built like large ones, but narrow and high, looking a little top heavy. They are set on four-wheel trucks and have seats for one passenger on each side. The lighting is by oil lamps and the cars are heated by stoves.

The signal is given, the little engine puffs and is soon under way. You are so near the ground when in the car that the effect is like riding on a handcar, but needless to say, runs smoother. The

ROUNDHOUSE AT BRIDGTON.

track is perfect, and the ballast looks very good. The road was originally laid with 30 lb. rails, but these are being replaced with 50 lb. ones. The greater part of the journey is through woods and the scenery is beautiful. The foliage is just beginning to turn and the red leaves among the green look like little danger signals.

There are several stations along the way, mostly at saw-mills, and the road carries a great deal of lumber. In 55 minutes the train pulled into Bridgton, where I stepped off. I always make for the round-house or shops, and that is what I did this time. I soon made the acquaintance of Mr. M. M. Caswell, Superintendent of Motive Power and Purchasing Agent of the road. A more obliging or a pleasanter gentleman I never met, and he knows his road like a book and every thing he manages is well done.

The motive power consists of five locomotives, three of the Forney type and two of them are 2-4-4's. No. 1 was built by the Hinkley Locomotive Works, of Boston, and is the smallest locomotive I have ever seen in regular service. She has the bell on the sand box and the cab looks out of proportion in relation to the rest of the engine. She weighs sixteen tons in working

PORTER "FORNEY" ENGINE ON THE B. & S. R.

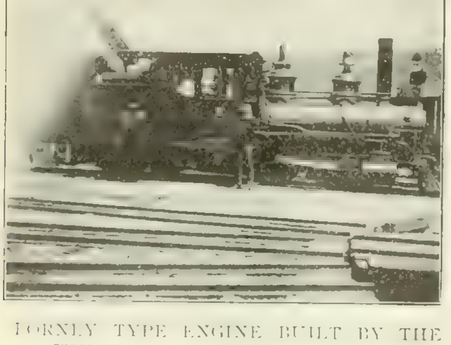
order. No. 3 was built by the old Portland Co. in 1892 and is also a Forney, but three tons heavier than No. 1. The next engine No. 4, is a Porter-Forney, built in 1902, with the dome inside the cab. Nos. 5 and 6 are beauties, built

by the Baldwin Locomotive Works, and weigh about twenty-eight tons, a big increase since No. 1, and also quite an engine for a two-foot gauge. They were designed by Mr. Wilfred Caswell, son of the superintendent, who is a consulting engineer with the Baldwin Works. The leading truck has outside bearings and makes a very steady running engine. The cabs, though small, are very comfortable, and have all the latest fittings. In a word, the machines show careful designing everywhere. I am sending you a good picture of No. 6, cylinders 11½ x 14 ins., 35-ins. drivers, 41-ins. boiler. Weight in working order 55,650 lbs.

There is on this road a real little round-house and turn-table and some very complete shops. The tools are driven by belting from an alternating current electric motor. Mr Caswell keeps all the motive power himself, and has made several improvements for his machines. All the equipment, engines, passenger and freight cars are provided with the Eames vacuum brake, but instead of using a rubber diaphragm, a regular brake cylinder is employed. A spring outside the cylinder normally keeps the brakes off, and the atmospheric pressure compress this spring when the brakes are set. These cylinders are a great improvement over the old-fashioned diaphragm and save lots of worry.

Another fact worth mentioning is that the road is equipped with Climax ¾ standard couplers.

As before mentioned, there is a full assortment of rolling stock, including three sizes of box cars, 26, 28 and 30 ft. long by 6¾ ft. wide. There is even a red tank car; so the Standard Oil Company has reached out to Bridgton. In winter the line is kept clear with a wedge snow plow. This is a fine piece



FORNEY TYPE ENGINE BUILT BY THE HINCKLEY LOCOMOTIVE WORKS.

of work, built of dove-tailed wood and loaded down with pig-iron.

Though the road has been operated for twenty-six years not one passenger has ever been killed. I was really sorry when I was obliged to say good-by to Mr. Caswell and his interesting system, but the boat was waiting and I hoped to also enjoy the sail down Lake Subago and through the Songo River, which completed my interesting day's trip from Portland.

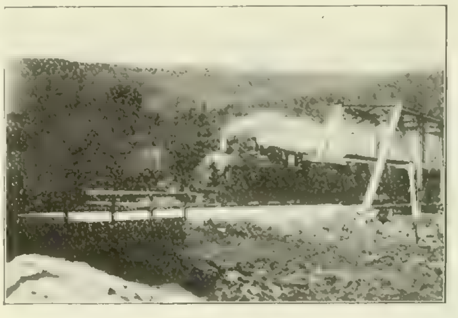
HUGH G. BOUTELL.

Urbana, Ill.

Railroad Apprentices.

Editor:

In these days of intellectual progress, when everyone has an opportunity to study the details of any branch of mechanics, when text books and magazines are to be had at nominal cost, there seems to be little or no excuse for young men to grow up to-day without being thoroughly posted. Many men consider practical experience the only reliable teacher. The ignoring of text books and magazines intended to educate us is merely the putting aside of the experience of those men who have brought mechanical thought to its present high standard; it is the same as saying "We do not care how much anyone knows; we are going to find it all out by ourselves."



MAINE CENTRAL EXPRESS AT BRIDGTON JUNCTION.

There are many machinists to-day who are excellent workmen, who have acquired all their knowledge by hard knocks, by long association with their particular line of work. In the majority of cases, these men, while being able to do the work themselves, are unable to tell anyone else how to do it, or to explain the necessity for the various operations. They can do the work only one way, because it is the only way they learned. These men are valuable in their place, but when we consider their ability, we must regret their lack of education.

Many of our machinist apprentices to-day are growing up in much the same way. The tendency all over the country nowadays is to have schools for apprentices, where they are taught to read drawings and make drawings themselves; where they are given examples to solve which affect their chosen calling; where they are given the most careful attention with a view to aiding them to become intelligent workmen. But in the smaller institutions, where there are no apprentice schools, the young man is left more to his own resources. He is interested in his work as a rule, but he is too apt to simply learn how to do the work without considering the why and wherefore. The first time conditions are changed from what he knew them in learning to do the work he quickly discovers how little he really knows about the matter.

BALDWIN 2-4-4 ON B. & S. R.

In locomotive work most apprentices become good machine men, but generally do not become so efficient in floor work. This is evidenced by the fact that it is an easy matter to secure a machine hand, but good floor men are scarce. There are not many branches of floor work which must be mastered by the apprentice in order to make him a desirable machinist. First of all, he should be thoroughly familiar with shoes and wedges. This of course includes the boxes and the rods, which can hardly be separated from the subject. The fitting of driving boxes, at one time a job only second to the mysterious operation of setting the valves, is to-day almost lost sight of. In some locomotive shops they even bore the driving box brasses larger than the journal and the "fitting" of the box is done simply by touching up the high spots with a file, merely an extra precaution. We used to hear the old-time engineers tell about reducing their rod brasses. They gave this work the most careful thought and considerable time. To-day, this is such a short and insignificant job we put but small time on it and pay but a small price.

The second important detail of floor work are the guides and pistons. This of course takes in general cylinder work, crossheads, etc. The third detail referred to is the valve motion, which includes the laying out of main axles, proper placing of eccentrics, work on valve motion parts and the setting of the valves. If a machinist is properly equipped in these three details of floor work, he will be able to overhaul an engine truck, put up spring rigging, brake rigging, take out or replace frames, or any other work around the locomotive.

Too many men will work on a piston valve without considering whether it is inside or outside admission; they will work on the compounding features of an

engine without taking interest enough to learn its operation; and there have even been cases when men who have worked around locomotives for a considerable length of time could not properly describe the passage of steam from the boiler to the cylinders and out to the atmosphere. The object the writer has in view is simply to bring out the idea that it is absolutely necessary for young men learning to be machinists to keep posted on what other people are doing, to go into the subjects of the business in more than a superficial manner, so that they will not only know "how," but "why" also. The first thing necessary is proper interest and determination. One great help is to take a magazine which treats of locomotive work, and, as time goes on, get practical books on the important features. This article, while having reference to machinist apprentices, is not out of place for apprentices of other callings, as the same principles are true in their cases also. It is one of the greatest privileges a young man has—"to learn."

EMPLOYER.

Jersey Shore.

Bank vs. Level Fireing.

Editor:

Having been a constant reader and subscriber of your Journal since 1891, and seeing no little comment on bank vs. level fireing of bituminous coal in locomotives, I beg leave for a small space in your very valuable paper, to give a little of my experience in the above fireing methods.

First of all I am like Mr. Phelps in his letter printed in your October issue, headed, What We Know and Don't Practice. Now, what we know and practice is the greatest coal saving device and also the greatest smoke consumer yet known to science. But what we know and don't practice is vice versa.

I have also been of the same opinion as Mr. Donaldson and have always advocated bank fireing, especially on long road or division engines, for on page 377 of September number where it says making a good start, has always been my experience with light or level fires on hard runs.

In the first place there should be more care taken at ends of divisions with ash pans, grates, dampers, etc. Now, if a fire is built new or is an old one pushed down in good time, say two hours before train leaving time, and is allowed to burn through, and the fireman is a good careful man who will add coal to the fire from time to time, so as to have a good solid bank before leaving, he is prepared to go on the open road with any kind of a train, and make any kind of time with very little trouble to keep up his fire, and with very little smoke if any; but the fireman who starts with a light fire has all kinds of trouble with his fire, and makes all kinds of smoke, and as the old saying is, he is never up with the game until he is half and sometimes two thirds of the way over the division. This has been my experience especially with the Atlantic type engines, but on the other hand as Mr. Phelps says in his experience with his different enginemen, poor fireing does not always lie with the fireman. This may be my case, but I will leave it for some one else to be the judge.

I have just returned from a trip of about 6,500 miles in which I rode several hundred miles on the locomotives of the following railroads: New York, New Haven & Hartford, Penna. and leased lines, Grand Rapids & Indiana, Chicago, Great Western, Chicago, Burlington & Quincy, Chicago, Rock Island & Pacific, and Atchison, Topeka & Santa Fe, and found that all the firemen carried a bank fire except the

NORTHERN PACIFIC LOGGING TRAIN.

Santa Fe men, who carried a very light fire, in fact there was not over 6 ins. of fire on the grates of any Santa Fe engine at any time that I rode on them. This I attribute to Baldwin Balanced Compound engines, as the exhaust was very light on fires, thus permitting the fireman to do as above stated. Those men have not used a fire hook or hoe in 18 months, and by the look of the tools covered up in the coal on tender I think it would be safe to say they were never used since engines were built.

The Rock Island, and the Chicago, Great Western men deserve great credit for their smokeless fireing. I will give you some facts of heavy bank fireing that you will say cannot be done with a level fire. This was done by the writer.

When I first started what I termed long distance fireing (I had one of the best scientific firemen in the country and who could make any coal saving or smoke consuming device sick in one trip) we were a little timid as to the distance we could go with a heavy train and an Atlantic type engine having a modified wide firebox, having 38 inches of front end of firebox bricked off, making it that much shorter. We made the following trips, with distance and number of cars hauled without putting any coal in firebox or in fact without looking into the firebox, much less putting coal into it.

1st. 27 miles, having eight Pullman sleeping cars 12 wheel, and one 12 wheel combination car.

2nd. 33 miles, having three 12 wheel Pullman parlor cars, and three 8 wheel day coaches.

3rd 34 miles, eight 12 wheel Pullman sleeping cars and one 12 wheel combination car.

4th. 42 miles, having nine 12 wheel Pullman sleeping cars and one 12 wheel combination car.

5th. 52 miles having six 12 wheel Pullman sleeping cars, one 12 wheel combination car and one 12 wheel mail car.

6th. 68 miles, having same train as on 5th trip.

7th. 79 miles, having same train as on 5th and 6th trips.

8th. 47 miles, having four 12 wheel Pullman parlor, three 8 wheel day coaches, and one 12 wheel mail car, making four regular stops for passengers, baggage and mail. On all other trips we made two regular stops.

On the 8th trip the fireman on arriving at the engine-house only had tender filled with water and after covering the fire over with about 15 shovels of coal the engine was put in the engine-house. Two hours later we started on our return trip, the fireman fired the engine in the regular way for first 24 miles and then put the shovel and all firing tools away and came over the rest of the division (66 miles) without getting off his cab seat, having three 12 wheel Pullman parlor and three 8 wheel day coaches. We covered the 90 miles in 1 hour and 45 minutes, and made three regular stops. The engines of which we had four on these trips, were all of the same class, and none of them went below 190 lbs. of steam—they all caried 205 lbs. Now some of your readers may think this division is all down grade, but it is what is termed a level road, as grades are few and not very long. In this long distance fireing I can say I never had a fire knocked out or a flue to leak and we have been doing this for years.

Mr. Roesch in his remarks says it requires just as much skill and judgment to fire a bank fire as it does a level fire. I think it requires more, and if any of your readers will try a 79 mile run without fireing engine in any way, as we did, they will agree with us.

Only for fireman being promoted to engineman we were going to try to cover the 90 miles without fireing the engine.

In conclusion I will say that the above is the reason I always have been in favor of bank fireing, and especially

so for smokeless fireing in and around these large cities, We had 2 hours and 8 minutes on all trips except this one.

Now let some of your good readers on other roads try their hand at long distance fireing, and let us know through the columns of your valuable paper what they can do. Wishing you every success.

Martin H. Lee.
Engr. N. Y. Div. of P.R.R.
Philadelphia, Pa.

Railroads Need Friends.

Editor:

At a recent meeting of railway supply men the remark was made that the railroads are in need of friends. Believing that this is true, the writer begs permission to make certain observations which he conceives to be material.

The writer frankly admits at the very outset that his sympathy is with the railroads, not because the latter are always right in their contentions, but for the reason that many of their troubles have been, and still are, due to governmental ignorance, incompetency and prejudice. One has only to glance back at the history of railroads in this country to find that the above statement is incontrovertible. It is a well-known fact that the present agitation against railroads is largely the result of the misdirected efforts of unscrupulous and self-seeking politicians.

The time has therefore arrived when all courageous citizens should come forward and give their support to some scheme by which those public men who thrive on the perverted uses of political power may be crushed and swept into oblivion. Railroad men of all ranks are beginning to realize that they must either institute an organized warfare against demagogism and all the other pernicious "isms" of the present time, or suffer the consequences of their political inactivity. The writer is well aware of the fact that a letter on some technical subject would have been more appropriate for your paper, but hopes that the sincerity of his interest in the welfare of American railroad men will entitle him to a fair hearing in your correspondence columns.

Arthur Curran.
New York, N. Y.

Derailment of Tenders.

Editor:

As all railroad men are interested about the derailment of tenders, those on the road more than any one lot. It seems the superintendents of motive power are in the woods about this. Before the large power was put in use we had a very small number of derailments of tenders, the reasons given are: First it is fast running, so the engineer is brought on the carpet, but this won't hold water. Then bad track to some one else. It occurs on points of curves at ends of curves, on straight line going up hill, running slow, also fast, and a very few times of drifting down hills. They have changed side bearings, placed trucks farther apart, all of these defects were fixed and they still have the derailments. I notice the center castings have not been increased in proportion to increase of weight on the tenders, and the splash of water is not provided against, as it was in small tanks.

I notice when tanks are raised off center, it is found that centers are rubbing one another. If you put graphite grease in centers you will more than likely stop the derailments till this is worked out, and the castings become dry again, causing extra friction and derailment. The splash of water in tank in almost all cases takes place when tank is half full or less of water, and you have your derailment.

I would say that if these things are noticed they could improve the center castings on the tenders and could remedy this splash of water if they would. I might give figures and hash over quite a number of cases, but I think all roads that have large power have got these troubles.

One That Rides These Engines.
New Albany, Ind.

Derailment of Tenders.

Editor:

From the articles in your October number I conclude that some one is having trouble from derailment of front tender trucks, and from the daily press I learn that some of our Presidential candidates are being delayed from the same cause. I, therefore, give you my personal experience with five or six such derailments on different roads.

There are usually two or more causes for any derailment, and when the engine wheels pass and front tender trucks derail, it is time for mechanical men to hunt the trouble, which will often be found in long drawbar connections. We often find drawbars with eighteen inches or more under the deck and still more back of front end sill of tender, which in my opinion is wrong. We sometimes find front trucks too far back from end sill.

Tenders with drawbar connections arranged so that the pin will pass through drawbar in front of end sill so that tender will be pulled by the end, as it were, and free to swivel in either direction, with wheels as far ahead as possible to clear water hose and with back side bearings clearing about 1/16 in., no front side bearings and with center plates of the flat bearing surface type, as large as bolster will allow, will not derail but will ride nicely on most any old rail.

This kind of drawbar connection also prevents, in a measure, the irregularities due to counterbalance being transmitted to the coal pile, though a spring arrangement on chaffing casting of engine is preferable for this purpose.

The writer has stopped derailments by making changes along the lines suggested. The derailments referred to have in nearly all cases been on curves and at reasonably slow speed.

The drawbar casting on tender should be reasonably massive to absorb the shock from coupling to cars in switching, etc., and thus prevent injury to end of tender frame.

If you think this will be of benefit to any one you are at liberty to use it as you may think advisable.

J. S. Booth,
Chester, S. C. Master Mechanic.

Nuisance of Automatic Stokers.

Editor:

"Advantage of the automatic stoker," is a subject that has received a great deal of discussion during the last ten years; but very little useful information upon it has been forthcoming. What I should like to know, and what many enginemen would like to know is: what are the advantages of automatic stokers? I have run a locomotive provided with an automatic stoker, and I watched the operation of the apparatus very carefully, having been prejudiced in its favor at first; but I failed to find any advantage either to the company or to the enginemen. The fireman has about the same amount of work to do as when he is doing the firing unaided, and there is always added responsibility in seeing that the coal jerker is kept in order. Then the work of making the machine put the coal on the right place is more arduous than using the scoop. The engineer has added to his responsibilities the caring for an extra attachment to the already overburdened engine without improving the working of the engine in the slightest degree.

An automatic stoker uses more coal to make steam indifferently, than a good fireman would use to keep her hot all the time. Smoke prevention is a very exacting demand with railroad officials now-a-days and an automatic stoker is an automatic smoker at its own sweet will, which brooks no interference without risk of disaster. I have never met an engineer or fireman who have used an automatic stoker who hankered for that adornment to the locomotive he was connected with. A fireman has fairly hard work keeping a battle-ship hot, but he bears the hard work cheerfully when forced from the annoyance of keeping machine stokers going when it has as many kicking moods as an army mule.

Marion, Ohio. Freight Engineer.

Angus Sinclair's First Engine

Experience Told by Himself

The old locomotive 65 of S. N. E. R., which means Scottish North-Eastern Railway, has a particular interest to us, through having been the first engine run

LAURENCEKIRK, WHERE ANGUS SINCLAIR BEGAN WORK.

by Angus Sinclair. The engine was small, with cylinders 10 x 16 ins. and driving wheels 5 ft. diam. In the latter part of its career the engine was converted into a double-ender for suburban business, but when Mr. Sinclair was operating it the engine had a tender and was employed on any service performed by the company. In fact the engine was built before railways had made much progress in specializing locomotives for particular forms of train service. Those were the days when railway companies were afraid of making their enginemen effeminate by protecting them from the weather. As will be seen, the bare boiler head was the sole protection that the enginemen had from the frequent rains of summer, the biting wind blast and snow storms of winter.

The group of engines (two—65 and 66) to which this one belonged was built in some city foundry whose name was forgotten long before the picture of the engine was taken. A peculiarity of locomotive construction in Great Britain for many years of the early railway era was that nearly every machine shop and iron foundry was ready to bid on the building of locomotives. This 65 was one of a class with the particular builder to fame unknown. Some wonderfully and fearfully made engines were sold to railways under that system of production, but the 65 has very few freak features.

There used to be a boast made by early locomotive builders that they did their work so well and so substantially that engines never would need repairs until they went into the shops for a general repair. That was true with some makes that were such rattle traps that they were ready for a general repair or even the scrap heap by the time they had run ten thousand miles. With the durability promise in view, the 65 had the valve motion put up in such a form that when even a valve stem broke the whole eccentrics, tank and connections on that side had to be taken down before the valve could be set to close the ports. Dr. Sinclair tells of having to take down the motion of this engine on a rainy day when he was in front of a passenger train. Most of the passengers of the train went forward and poured out their vials of wrath upon the poor engine driver, who was lying on his back taking the soaking that was hardly more disagreeable than the abuse of the passengers. This is a well known peculiarity with the travelers in Europe when any mishap causes delay.

He contrasts that experience with the treatment he received on meeting with the first mishap to his engine on an American railroad. It was away out in Iowa on a short line called the Chicago, Clinton & Western, an overloaded name that was popularly shortened with The Plug. The track had been laid upon the virgin prairie without surfacing and it was decidedly uneven, especially after

FIRST ENGINE FIRED BY ANGUS SINCLAIR.

wet weather. One day when passing through a cutting noted for its bottomless character, the tender of Sinclair's engine jumped the track. He proceeded at once to get the wheels back upon the rails, thinking, "Now I am in for it from the passengers." To his astonishment several of the passengers came and volunteered their assistance and cheerfully toiled in the mud, while others sat upon the bank and cracked jokes suggested by the situation, but never a hard word was uttered against the engineer or the company he worked for.

Tourist (after a long discussion with station master on the subject of catching a steamer)—So you would advise me to come back by the Sunday night train in order to catch the boat on Monday morning?

Station master (cautiously)—Ah would advise nae man tae profane the Sawbath; but a'll just repeat—if ye wait till the Monday ye'll nae get the connection.—*Punch.*

The Enginemen Accused Unjustly.

When improved conditions are demanded in engine service the tendency is to go for the enginemen and complain of them for inferior service, when perhaps badly designed engines are really to blame. On a well-known western trunk line, locomotives were used with boilers so small that washing out had to be done at the end of each trip. A new superintendent of motive power being appointed, he investigated the cause or necessity for so much washing out and decided that the boilers in use had too small steam and water capacity. Engines with big boilers were then introduced, and they would run two thousand miles between washings. The service was much improved by this change.

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Power Direct from Coal.

A short time ago a press dispatch from Denver, Col., printed in one of the daily papers under the heading of "Power Direct From Coal," represents Mr. Thomas A. Edison, when referring to this matter, as saying:

"If I do not reach it myself I will live to see the day when power will be utilized from coal without the aid of steam. We are working in that direction, and some morning the world will be informed that the discovery is a fact. Electricity is many times more effectual than steam. In a few years a steam railroad will be a novelty."

Whether or not Mr. Edison used the words attributed to him is of no great consequence. It is very probable that he has been misquoted, but the dispatch reveals the spirit and desire for the very novel, and the sudden, which is characteristic of the daily press of our day. The desire may or may not be natural, but the confident expectation of it has always appeared to us as unwarrantable.

The history of the development of the steam engine, the locomotive, the steamboat, or even the flying machine has but one lesson for all thinking men. The history of all these is the record of long, laborious endeavor, marked by slow progress and many failures. There is nothing in all the stages set down on the page of this history which even remotely resembles sudden achievement. The law of evolution is as potent here as it has been in the gradual uprising of mankind from brute ancestors. The lapse of time in the growth of man's knowledge and mastery of the forces of nature is small indeed compared to the vast period required for his own development, but there is present in both cases the orderly sequence of events which we call progress, and that there have been steps is apparent in each.

Some years ago attention was attracted to the work of Dr. W. W. Jacques of Boston, in the production of electricity direct from coal. His was a laboratory experiment, and the production of the electric current, we are told by a writer at the time, was effected by the insertion of a prism of carbon into a melted mass of caustic potash, the whole contained in an iron pot. One wire was given off from the pot and the other from the carbon prism. An incandescent lamp on this circuit proved the flow of current. The iron pot however, was heated to a temperature of between 400 deg. and 500 degs. Centigrade by means of ordinary coal fire beneath it. The caustic soda was impregnated with air, forced into it by an air pump, and the oxygen in the caustic soda combined with the carbon prism, and a current of electricity was produced.

There is here the burning of fuel in order to heat the pot and there is the operation of an air pump, both of which consumed energy from some outside source, and it is a question whether the expression "electrictiy direct from coal" when applied to this ingenious and interesting experiment is not somewhat misleading. No great progress has so far been made, so far as we know, in the production of electricity direct from coal, and certainly nothing has come to light that can be called a commercial success.

It is of course unwise to predict from one instance of honest endeavor not wholely successful, that all attempts will be failures, whether this be in the production of power from coal or the development of the airship, but it is only sane and rational to look to the future by the light of the past, and in so doing one will be compelled to expect attempt followed by failure and greater knowledge slowly acquired wherewith to prosecute further research. The sudden retirement of the steam engine or the locomotive would be nothing short of an economic calamity, and the history of the past gives no hint that such is, or can be, in store for us. We do not for a moment say that the present order of things cannot change, we confidently expect the change that orderly progress will bring, and no man can doubt that great and mighty advances will be made in every department of human endeavor, as time goes on, but time is not only one of the factors in the solution of the problem, but it is an important and essential factor.

Herbert Spencer in his "First Principles" says that "it is an established mechanical truth, that if a body moving at a given velocity, strikes an equal body at rest in such wise that the two move on together, their joint velocity will be but half of that of the striking body. * * * * A body moving at velocity 4, cannot by collission, be reduced to velocity 2 without passing through all velocities between 4 and 2."

There is here in this law of continuity, as it is called, the absolute necessity for the conception of an infinite number of velocities or rates of motion which is gone through by the body in changing from velocity 4 to velocity 2. There is no such thing as instantaneous starting or stopping in nature, though the process may appear rapid to us, and it seems fair to apply this method of reasoning to the case before us. Progress may have surprises for us, but it is never sudden. "For precept must be upon precept, precept upon precept; line upon line, line upon line; here a little and there a little."

Steam vs. Electricity.

The relative merits of steam as against electric traction have many times been set forth, and the advocates of electricity have always evinced a remarkable readiness to "show cause," as the lawyers would say, why their method of train operation should be adopted and why the steam locomotive should be relegated to the scrap heap. The more conservative thinkers on both sides, however, are now pretty well in agreement that steam has its recognized field of operation, and electricity has also its well defined sphere of influence, to borrow a diplomatic phrase.

It is probable, though by no means certain, that if at the present time there were no railways in operation, and that the railroad world had as much experience and knowledge as it now possesses, electricity might be chosen in preference to steam. We have not to choose now for a primary installation our choice as a rule, involves the discarding of a satisfactory and a proved system and the adoption of another. Steam locomotives are self-contained units, and are not dependent on a cen-

tral station for their power. If one of them breaks down so that it cannot be temporarily repaired, another can be substituted without disorganizing traffic. The electric locomotive is also a unit which if temporarily deranged can be side tracked and a substitute provided. Both are thus far on an equal footing.

The electric locomotive, however, being dependent on a central station, has the disadvantage of possible disablement by a failure at the power house, in which case a whole section of the line becomes inoperative. This contingency is no doubt remote, but it exists. There is another and even more important factor in the problem, and that is the commercial value of the steam when compared with the electric locomotive. In this as in many other things, circumstances alter cases, and the successful and economical installation of electric traction on one road, does not necessarily imply that its adoption would prove equally nemunerative on another, and differently conditioned railway. So widely do conditions vary that there are undoubtedly cases where the adoption of electricity is the wiser course to pursue, even if the financial aspect of the case may not seem to warrant it. Operating dense traffic through tunnels or in crowded cities, is a case in point, and at terminals where electric current can be used for other purposes as well as for moving trains, is another case in point. The several particular cases however, where electricity may be found advantageous do not constitute a basis for concluding that electrictiy is always the better of the two, nor do they lend sanction, to the idea that steam propultion even if more economical from a monetary standpoint is necessarily always the best. The question of steam vs. electricity is very much like a case, in law which has to be tried upon its merits in court. There may be precedents and there may be authority for this view or that, but the case stands or falls in the end by reason of its own inherent merits or its own inherent defects, judged by themselves and without depending upon how other seemingly similar cases have been decided.

Roundhouse Foremen's Association.

The suggestion made by Mr. A. H. Riddle in our October number, that a Roundhouse Foremen's Association be formed is excellent. The roundhouse foreman is certainly the man who keeps things moving, the man who has to endure more grief than any other railroad official. He has to stand the fault-finding of enginemen who cannot have their own way when two or more claim favorite engines or the same comfortable runs, and he has to stand the snarl of the master mechanic when impossibilities are not made practicable performances.

In the care, maintenance and prompt repairing of locomotives, heavy responsibilities are frequently put upon the engine house foreman. Many of the engineering problems discussed by the Master Mechanics and the Traveling Engineers' Associations, turn on the work and duties performed by the roundhouse foreman. There is every reason then why he should be given the privilege of discussing in an association of his own, the duties and difficulties that fall upon his shoulders.

We shall be glad to give all assistance in our power to this movement and hope to see its practicability discussed in our columns by the men most interested.

Full Publicity Works Well.

A curious result of the practice of giving out full particulars concerning railway accidents, adopted by the Union Pacific Railroad, is the fact that it has greatly diminished the appetite of newspapers for sensational details concerning railway wrecks. It has also protected the road from false statements and has prevented many communities from forming hasty, biased or hostile estimates of the road when an accident takes place. This might seem to be a good reason for the adoption of the publicity plank in their platform by the Associated Lines, but there is also another and much more satisfactory reason why this kind of systematic publicity does good. It helps to maintain efficiency and supports discipline.

The method adopted by Mr. Julius Kruttschnitt, director of maintenance and operation of the U. P., is briefly the ascertaining of the cause of any disaster, placing the blame squarely where it belongs, and at once letting the public know all the newspapers can tell about it. The way the system is carried out is briefly this:

When an accident occurs, the superintendent, master mechanic and engineer of the division go at once to the scene and at once form a board of inquiry, composed of themselves and one or more leading citizens of the community. If this board fails to ascertain the cause of the accident, a second board is formed of the general superintendent, superintendent of motive power, engineer of maintenance of way and one or more prominent citizens. Should this board fail, a third board is formed with the general manager at its head.

The board of inquiry does its work quickly and often a newspaper representative is one of the number. The newspapers are given a full and correct statement of the facts. The effect upon the discipline of the road has been good. Every employe knows that if he is careless in the performance of his duty, his home town, and in fact the whole neighboring community, will know of it, and he will be a marked man in the eyes of his friends and fellow employes. This system practically means that an employe who fails in his duty is held up to the public gaze with his unenviable record full in the light, and it acts almost automatically to stimulate each individual to such wholesome effort as will relieve him from the necessity of appearing before the world as a careless or incompetent man.

To Prevent Breakage of Metal Ties.

The article on "Leather Tie Plates and Steel Ties," contributed to our October number by that eminent and venerable engineer, Charles T. Porter, deserves the serious attention of railroad managers and of every person whose influence might be felt in the conservation of our National resources. The demand for wooden track ties has led to the denuding of our forests to an alarming extent, and the evil progresses with increasing danger, because no substitute has been found to prove so cheap as wood with all its tendency to premature decay under the conditions a tie must endure.

When iron and steel ties were first introduced as a durable substitute for the evanescent wood, high hopes were entertained of the success of the stronger and more durable material, but the high hopes have gradually changed into depressed disappointment. The first difficulty with metallic ties was imperfect forms. By long and expensive experiments added to experience in different countries, a form evolved itself capable of being tamped and not given to too easy side movement. When this condition was reached it looked as if the problem of putting durable steel into the place of the decaying timber had been solved; but it only brought the engineering world to new and what seemed to be insuperable difficulties. In the first place the impact of metal to metal in the rail and tie produced disagreeable noise. The multitude of inventions tried to obviate the noise proved worthless, so some railway companies, particularly on the continent of Europe, said in effect: "What harm does the noise do? Let the passengers grin and bear it. The noise will help to keep people awake, something very much to be desired."

But the noise had a more serious indication. It turned out that the hateful noise was the product of vibration, and that vibration produced fracture.

The theoretical advantage of using metallic ties was principally the durability of the material which would out-

live many sets of wooden ties. When it turned out that iron and steel ties were shortlived owing to breakage, the object for using them had vanished. Now comes Mr. Porter with a simple remedy for both noise and breakage that ought to convert failure to success. The remedy is merely the placing of a leather lining between the metallic surfaces. The remedy proposed had proved successful in stone-cutting machines. There is no doubt but it would be equally efficient in preventing breakage of steel ties. We hope that some of our enterprising railroad companies will make the experiment, which could be carried out at trifling expense.

Railway Regulation in Canada.

Regulations as to trains, cars, engines and railway employees have been for some time under consideration by the Railway Commission sitting at Ottawa, Canada, in conjunction with representatives of the various railways. Amongst the proposed regulations are the following:

Each locomotive engineer must have had at least one year's continuous experience as a fireman, he must pass a satisfactory examination as to handling engines, brakes, etc., and undergo an eye and ear test. In fact, the proposal is that every employee shall have his sight tested. Regulations are also made concerning footboards on engines.

It is further proposed that railway companies must conform to the rules and regulations of the Master Car Builders' Association governing the loading of heavy materials. No material shall be carried on top of a car.

Crippled cars shall not be allowed behind the caboose on frieght trains. Cars containing live stock or perishable freight, when crippled in minor respects, shall be chained up ahead of the caboose and taken to the first terminal for repairs, when it is safe to haul such cars on chains. In no case are more than two such cars to be hauled in any train except where the cars have been disabled by a wreck and a special pick-up train has been sent out to bring them in. The object of the proposed regulation relating to the position of the one or two crippled cars in the train would seem to be for the purpose of guarding against the danger of crippled cars breaking away and being left on the main line without the knowledge of those in the caboose.

The definition of a crippled car has not been left to the individual judgment of the train crew, for the proposed regulations specify that a crippled car shall include one with any of the following defects: Broken coupler, disabled coupler, cracked wheel, chipped flange over 2½ ins., broken wheel flange, bent axle or journal, broken arch-bar or truck steps.

In order to enforce the strict compliance with these regulations the commission recommends that railway companies, or their officers, agents or employees, or any of them, disobeying or failing to comply with the provisions of these regulations shall be liable to a penalty of $50 for each offence. Thus it appears that the individual is not to be allowed to shelter himself behind the company, but in case he, and not the company, is to blame the penalty will be inflicted upon the person or persons at fault. The object sought in this case is evidently a determination by the commission to compel the company to use all diligence in the matter of constant effective supervision of its employees, and that when such supervision is held to be defective, by reason of non-compliance with the regulations, the company will be fined.

Other regulations, proposed by the commission were sent to the various Canadian roads. These provide that every freight car built after December 1 shall be equipped with air brakes and have operating levers for couplers on both sides of the end. No freight train shall be allowed to proceed on its journey unless three-quarters of the cars comprising it have air brakes. The number of cars to a train shall be left to the judgment of officials, but in the case of a doubleheader the leading engine shall control the train.

On the main lines no light engine shall be run more than 25 miles in one direction without a conductor, in addition to the engineer and fireman. On branch lines the operating officials shall determine the need of conductors on light engines.

Passenger trains shall carry at least one brakeman of not less than one year's experience as a brakeman, and shall also carry a baggageman, provided that passenger trains of eight or more cars shall have at least one additional brakeman.

Conductors must have one year's experience as brakeman and be 21 years of age. Telegraph operators must be at least 18 years of age, able to write a legible hand, to send and receive at least twenty words a minute, and to pass an examination upon train rules and the working of telegraph offices.

These regulations, which have been practically concurred in by the railways, will when sanctioned by the commission have statutory force. The object is to secure a greater measure of safety for the traveling public and also for the trainmen, locomotive engineers and firemen themselves. The regulations seek to definitely embody good railroad practice without the introduction of restrictions which would hamper traffic. The adoption of the Master Car Builders' Association rules for loading heavy material is a compliment to the careful work which has all along characterized the recommendations of that body.

Fewer Idle Cars Means Business.

A recently issued bulletin from the car efficiency committee of the American Railway Association shows that the number of idle cars has been reduced to approximately 8 per cent. of the total number owned by all the railroads that are members of the association. It has been estimated that the association roads own and control about 2,200,000 cars. Since the end of July last, there has been a steady decrease in the percentage of idle cars. The number of cars out of service was practically stationary, and compared with April it is now considerably less than the cars not in use at that time.

Following the reports of a constant decrease in the number of idle cars, railroad officials, especially those in the Trunk Line Association, speak encouragingly of a revival of business and predict an improvement in the volume of traffic. The principal carriers of grain are hopeful and railroad men say that the iron, steel, coal and manufactured goods business is picking up.

In a press dispatch from Boston last month Mr. Lucius Tuttle, the President of the Boston & Maine Railroad, is quoted as saying, "Traffic conditions are beginning to improve. Since Sept. 1 there has been accumulating evidence of an improved business situation. This improvement, of course, has not been very pronounced, but sufficient to make us believe that we have struck bottom. We are looking for this improvement to continue."

Railway Mileage in the U. S.

There is always a great deal of interesting and accurate information contained in the report of the Interstate Commerce Commission. Here is something on the railway mileage of the country:

The report shows that on June 30, 1907, the total single-track railway mileage in the United States was 229,951.19 miles, or 5,588.02 miles more than at the end of the previous year. An increase in mileage exceeding 100 miles appears for Arkansas, California, Colorado, Florida, Georgia, Idaho, Louisiana, Mississippi, Nebraska, Nevada, North Dakota, South Dakota, Texas, Utah, Washington, West Virginia, Wisconsin, Wyoming, and New Mexico.

Substantially complete returns were rendered to the Commission for 227,454.83 miles of line, operated, including 8,325.97 miles used under trackage rights. The aggregate length of railway mileage, including tracks of all kinds, was 327,975.26 miles. This mileage was thus classified: Single track, 227,454.83 miles; second track, 19,420.82 miles; third track, 1,960.42 miles; fourth track, 1,389.73 miles, and yard track

and sidings, 77,749.46 miles. These figures indicate that there was an increase of 10,892.07 miles in the aggregate length of all tracks, of which 3,988.55 miles, or 36.62 per cent, represented the extension of yard track and sidings.

The number of railways for which mileage is included in the report was 2,440. During the year railway companies owning 2,811.65 miles of line were reorganized, merged, or consolidated. The corresponding figure for the year 1906 was 4,054.46 miles. The report shows that for the year ending June 30, 1907, the mileage of roads operated by receivers was 3,926.31 miles, or a decrease of 45.12 miles as compared with 1906. The number of roads in the hands of receivers was 29.

The Steam Gauge.

In spite of the fact that much improvement has been made in the construction of the steam gauge it is well known that these gauges are not always correct. The variation, however, when it does occur is usually on the side of safety, that is, the gauge will record a higher pressure of steam than is actually in the boiler. The trouble is frequently owing to the location of the gauge and also to its particular form of construction. If the gauge is of the bent pipe variety, the expansion of which under pressure moves the pointer in the dial, it has been found that unless these gauges are set with much care in the matter of their attachments, they are apt to err in the record of the steam pressure.

In this connection we may mention that there is in the Patent Office, department of this month's issue of RAILWAY AND LOCOMOTIVE ENGINEERING, a description of a clever device intended to remedy the weakness in this particular form of steam gauge. Instead of one hollow bent tube, there are a number of smaller pipes attached to a header, and these pipes are linked together at their flexible ends so that any variation occuring in them is equalized and the tendency to thus correct any variations that may arise from any cause is at least a mechanical possibility.

The practice of adjusting steam gauges by a cold water pressure might be improved upon. Metal subjected to any considerable degree of heat is not as rigid as under ordinary cold water temperature. It is therefore reasonable to presume that if a bent pipe will straighten out to some extent by the internal application of cold water under pressure, it will straighten out further when the heat applied reaches the boiling point, and everything else being equal, a heated guage will show a greater pressure, as recorded on the dial, than if the gauge and attachments remained quite cool. This variation is increased in the case of a gauge that is attached in close proximity to the surface of the boiler. It is good practice to use pieces of wood between the gauge and the stand or bracket to which it is attached.

As the winter approaches it is good practice to avoid by all means the possibility of the gauge or pipe leading to the gauge becoming frozen. The freezing of water in pipes, and especially in mechanism so delicate as that of a steam gauge, has a most pernicious effect. It may be claimed that under any condition, even when the gauge is incorrect, the safety valves being more substantially constructed are less liable to error, and that a slight variation of the steam gauge is of little consequence. It must be remembered, however, that the safety valves are often adjusted and occasionally readjusted to conform with the pressure recorded on the steam gauge, and while the construction of steam gauges has reached a high degree of excellence, there is room for improvement on a great many roads in the testing, and especially in means of attachments to the boilers of the modern locomotive.

Mechanical Stokers.

We do not remember of any device offered for the use of railroads that received a hearty welcome equal to that extended to mechanical stokers; but strangely enough, the success of the invention has practically been nothing. The automatic stoker came into use under the most favorable circumstances. It had many influential friends, and it appeared to be popular with enginemen and railroad officials. Automatic stokers have been introduced upon locomotives on several railroads, reported to be working satisfactorily, kept at work for a few weeks or months, then quietly removed. Nothing seemed to be against them except that the enginemen preferred to do their work without mechanical aid. "Freight Engineer" discusses the automatic stoker in another column of this paper, and we judge from his letter that the real objection to the device is that it adds an extra apparatus to be cared for. Similar objections were raised to injectors, air brakes, lubricators, balanced valves, and nearly every attachment to the locomotive, when first introduced, but they all made their way into favor. It may be the same with the mechanical stokers. We would be glad to have some information on the operation of the mechanical stoker when the work to be done clearly exceeds the physical endurance of the fireman, and we want to hear from firemen what they think of mechanical stoking.

Officers and Men on Common Ground.

According to a press dispatch from Chicago, there has been a new association recently formed called the "American Railroad Employees and Investors' Association," the aims of the organization being to promote a friendly public sentiment toward the railways. In our personal column we give the names of the officers of this association, in which may be found the chiefs of the various brotherhoods and presidents of railroads. The names thus grouped together show that responsible representatives of capital and labor are to stand shoulder to shoulder in an endeavor to prevent the enactment of legislation inimical to the interests of railroads.

The new association is to be non-partisan and will take no part in controversies between railroad employees and officials. Wherever the interests of railroad investors and employees are at stake, however, it is expected to exert a powerful influence.

The aims and objects of the association are thus set forth in a declaration of principles recently issued: "By all means to cultivate and maintain between its members such spirit of mutual interest and such concern on the part of all of them for the welfare and prosperity of American railroads as will best promote their successful and profitable operation for the benefit alike of their employees, investors and the public.

"To publicly provide means and methods of obtaining consideration and hearing from all legislative bodies, and commissions empowered to enact laws, rules and regulations affecting the conduct and operation of railroads.

"To do whatever lawful things may be necessary in order to secure a fair return alike to capital and to labor interested in American railroads, with due respect at all times to efficient service, fair treatment and safety to the public."

Book Notices

CONFESSIONS OF A RAILROAD SIGNALMAN, by J. O. Fagan. Published by Houghton, Mifflin Company, Boston and New York. 5 x 7½ ins., 181 pages, with illustrations, ornamental cloth. Price $1.00 net; $1.10 postpaid.

This is a notable contribution to the railroad literature of our time and has already attracted wide attention as the work appeared serially in the pages of one of the leading literary magazines. Railroad men should read this book. The effort to awaken a determination to a closer obedience to printed rules and regulations in railroad matters is laudable, and the moral effect of a perusal of the work is altogether wholesome.

Having said this much, we may be permitted to look a little deeper into the work. The author presents to us no real record of personal experiences. The work is not in any sense the confessions of a railroad signalman. It seems to us that it is rather the report of a railroad spy. The author is safely ensconced in an office, apparently in the yardmaster's department. It is difficult to know whether he graduates up or down when he becomes a signalman. His vision, of course, is broadened in the tower. He sees things, and tells what the railroad men say about each other. The signals they pass unheedingly, the blanks they sign by proxy, the hot-boxes they run along upon in the hope of reaching their destination, are recorded with solemn gravity. It is the vision of a child who sees the things that a child might see, and tells it all with open-eyed wonderment. Not only is there nothing new, but the real inner life of the railway man is absolutely not touched on in the pages of the book.

Some of the propositions advanced by the author are absurd in this age of advancing civilization. His claim that higher wages means less efficiency is abhorrent in principle, and followed to its logical sequence is equal to a statement that the best work is that which is done for nothing. There may have appeared to be some truth in this idea about the time that the Pyramids were built, but in justice between man and man it was false then and it is not true now. The laborer is worthy of his hire here and elsewhere.

The author's advocacy of the immediate discharging of railway men who by an error in judgment may cause damage or disaster is as senseless as it is cruel. An accident is a sharp lesson to a railway man, just as the spoiling of a piece of work is a sharp lesson to a mechanic. The chances of the same accident happening again in the hands of the same man is lessened. The real masters of the men are they who can so mould the minds of common men that they become uncommon. The best railroad superintendents are they who, ever watchful, train the men to a fine obedience to rules. The man who lets discipline decline from laxity to carelessness, and then suddenly, as if in anger, discharges some one, unfortunate enough to be mixed up in some accident, which is the outgrowth of his own weak system, is unfit to have authority over men.

We would not be understood as altogether condemning the author and his work. He has some, but not much, literary ability. His view is more the passing view of the earnest newspaper reporter anxious to expatiate lengthily on what he saw and heard, but was himself little or no part of the passing panorama.

Air Brake Catechism. By V. C. Randolph, Air Brake Instructor, Erie Railroad. 170 pages, flexible cloth. Price $1.00.

The author of this book is a railway man of much experience, and the work shows how thoroughly he understands the subject. The work includes a general discussion of the Westinghouse Brake and a very complete treatment of the New York air brake. The work has the merit of being up to the present date in the matter of explaining the latest details of the variations and additions, including the Duplex Straight air and automatic brake as well as the new E. T. equipment. The work is profusely illustrated and the drawings are of a superior kind. It is pocket size and a handy, useful and practical book.

Manual of Reinforced Concrete and Concrete Block Construction. By Chas. F. March and William Dunn. Published by D. Van Nostrand Company. New York, 1908. Price $2.50.

The object of this work is to give as concisely as possible, and in a handy form for everyday use, the methods to be employed in everyday problems. The authors have covered the whole field of reinforced concrete construction as it is ordinarily practised, and have also gone into the kindred subject of hollow concrete block construction. The contents include: Materials, construction, waterproofing and fire resistance, loads, bending moments, etc., hollow concrete blocks, tables, diagrams and general information. The book is about 4½ x 6½ ins., has 290 pages, is bound in red morocco leather, and is illustrated with 113 diagrams and figures. Among the diagrams are some which give at a glance the safe superload on slabs of various thicknesses, spans and reinforcements; strengths of hooped columns according to the French Commission's report. The new tables include useful data for obtaining the pressures on retaining walls, bins and silos; the spacing of stirrups in beams; sectional areas of metal per foot, width of slab for round or square bars, etc. The subject of earth and grain presures has also been fully treated.

The singular phenomenon of hard steel being cut by a rapidly revolving disk of soft steel has been somewhat puzzling. A microscopic examination by an English engineer, F. W. Harboard, has now shown that the metal acted upon is heated nearly or quite to the melting point of steel, but only at the point of contact with the disk.

Old, Old Firemen.

It would be interesting to know how many firemen there are on our railroads who have accepted the handling of the scoop as a permanent occupation. The writer noticed an old gray headed man filling the fireman's side on a switching engine one day lately, and by inquiry learned that the man had been a fireman for nearly thirty years. He was sent permanently to the left-hand side, because, as the engineer mildly put it, "Tom was no scholar." That meant that Tom could neither read nor write, and the master mechanic did not like to deprive him of the means of livelihood for himself and family.

At one of the Traveling Engineers' conventions, one of the members talking about the examination of firemen for promotion, intimated that some men failed after repeated trials, and were put to firing switching engines because the management did not believe in turning good men into the street even when they failed to pass examinations. That is a very humane attitude to take in such cases, but its wisdom from a business standpoint is doubtful. The proper time to gauge a fireman's intelligence is before putting him upon the payroll. A man may fail to pass an examination, and yet be a first-class fireman, in which case he should be permitted to remain in road service, if he is competent to read orders. Some good intelligent men who make first-class firemen, never make even indifferent engineers, and ought not to be trusted with a locomotive. Every traveling engineer knows of such men; but promote them once, and they have acquired certain rights that stand between them and discharge. Men of that character may be deficient in self reliance, lacking of good judgment and habitually given to losing their heads in emergencies, but these are not faults that can be formulated into a charge for incompetency, although the men are incompetents of the most dangerous type. It is amazing how many men of this kind fail to become acquainted with their own shortcomings.

A most respectable engineer of the incompetent type once confessed to the writer that he used to listen to the exhaust notes, and imagine that they were saying, lord-bless-my-soul. One night as he was pulling a passenger train, one of the notes went astray, and the best he could make out was lord-bless-my. It did not strike him that the lost note meant anything going wrong, until an eccentric strap broke, and then he exclaimed lord-what-a-smash.

People who enjoy reading a good story and like to combine pleasure and profit in their reading, should use the lengthening evenings to read Sinclair's "Development of the Locomotive Engine."

Applied Science Department

Elements of Physical Science.

Second Series.

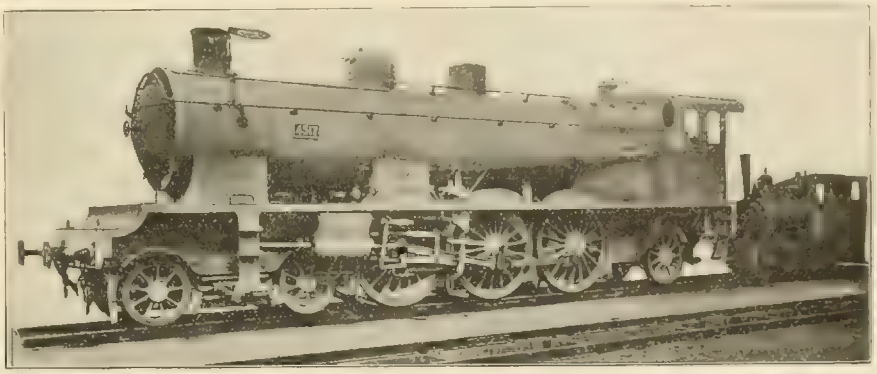
II. HEAT, WORK AND HORSE POWER.

The relation between heat and work has been experimented upon so carefully that the unit of heat has been established with a degree of certainty equal to the measurements used in space or weight. Taking water at its greatest degree of density, which is 39.2 degs. Fahrenheit or 4 degs. Centigrade the unit of heat is calculated as the amount of heat necessary to raise the temperature of one pound of pure, distilled water one degree. Work may be measured on a basis equally simple and correct by assuming that the amount of work accomplished may be measured by raising a certain quantity of weight through a certain amount of space. It is literally pressure acting through distance. On this basis the unit of work becomes a simple problem of multiplying the weight of the object moved by the space through which it has passed. One pound in weight raised through one foot of space is known in such calculation's as a foot-pound, and this is the mathematical conception of work, and in steam engineering the conversion of heat into work is the mechanical problem, while the measurement of the amount of work accomplished may properly be called the mathematical problem.

Horse power is the unit of work universally accepted by engineers, and it may be noted that James Watt, the inventor of the steam engine, was the first to establish this standard for the measurement of work. It represents 33,000 foot-pounds of work per minute, in other words, a horse power may be calculated as raising this weight one foot per minute.

It was the average of work performed by a London dray horse for a short time when Watt made his calculation, but it is somewhat in excess of the average work done by a horse for any extended period of time. It has nevertheless been accepted as a convenient unit by engineers. Any equivalent is also considered as a horse power. The raising of 330 lbs., 100 feet against the pull of gravity in one minute is a horse power, or the raising of 550 lbs. one foot high in one second of time, also constituted a horse power. The essential feature about a horse power is that it includes the time element, and in this feature it differs from the mathematical conception of work. In other words, power is the rate at which work is done, and a horse power is a definite standard of work done in a specified time, where the units pound, foot and minute are employed.

The application of heat to water, as already stated, has the effect, if the water be closely confined, of producing a pressure of steam which has the power of moving a weight as is shown in the moving of a piston backwards and forwards in a cylinder. By this means it is readily shown that the heat in the furnace can be transformed into energy that is sufficiently strong to move the piston against the resistance incident to the weight of the locomotive and the load to which it may be attached.



A 4-6-2 ON THE PARIS ORLEANS RAILWAY.

In calculating the horse power of steam engines it must be remembered that the pressure of steam is not equal during the entire length of the stroke of the piston. Not only is the initial pressure in the cylinder lower than the boiler pressure, but the tendency is to a further decrease on account of the rapid cooling of the metal of the steam chest and cylinder. Furthermore as the slide valve closes some distance before the piston has completed its stroke, a considerable allowance must be made for this decrease from the boiler pressure, even when the valve is in full travel. The ratio of loss usually allowed is equal to twenty per cent., so that eighty per cent. of the pressure of steam in the boiler is reasonable allowance in calculations of this kind. In the case of a locomotive where the pressure in the boiler may be at 180 lbs. per square inch, the cylinders measuring 24 inches in diameter by 20 inches in length, the velocity of piston travel being at the rate of 120 strokes per minute. That is, the piston moves from the front end of the cylinder to the back end of the cylinder and returns to the front end again, thus traveling through 40 inches of space, for one revolution of the driving wheels. The calculation for the horse power is as follows:

80 per cent. effective pressure of 180 lbs. is equal to 144 lbs. acting on the face of the piston. Area of piston 24 × 24 × .7854 = 452 square inches × 144 lbs. pressure taken as the average for the full stroke = 65,088 lbs. × 40 ins. or 3 1/3 feet = 216,960 × 120 number of strokes per minute = 26,035,200 foot-pounds per minute, divided by 33,000 = 789 horse power. A locomotive consisting of two engines would on this calculation equal to twice this, or 1,578 horse power. The formula as generally stated is easy to remember, being

$$H\ P = \frac{PLAN}{33{,}000}.$$

where P is the average or mean effective pressure in the cylinder in pounds, L is the length of the forward and backward movement of the piston and is twice the stroke in feet, A is the area of the piston in inches, and N is the number of double strokes per minute, and is equal to the revolutions of the wheel. The Master Mechanics' Association takes 85 per cent. of the boiler pressure as the mean effective pressure in the cylinders but for average condition 80 per cent. is perhaps better.

Prospects of Aerial Travel.

When any new device is brought [illegible]ously before the scientific or industrial world with any rational claim to decided merit, the tendency nowadays is to give

it an enthusiastic welcome. There have been great fluctuations of sentiment in the manner of welcome in things of a novel character, or of inventions that depart radically from the accepted forms. At various periods the facts have been permitted to lead sentiment towards inventions calculated to accelerate the wheels of progress, at other times the hard-headed unromantic business man, the man who rules by the force of accumulated capital displayed the will and had the power to make or mar the success of any inventor calculated to effect radical changes upon existing methods of production or of transportation.

During the long speculative period concerning the wonderful things that steam might be employed to perform, the poets gave the greatest encouragement to inventors and to engineers. There was no marvelous performance beyond the conception of people whose imaginations were restrained by no earthly obstacle. They peopled the air with wonderful prodigies flying through illimitable space under the inspiration of compressed steam. When the progress of invention brought to the capitalist invitations to aid in utilizing the forces that steam put at man's command he was content to confine his operations to the surface of mother earth.

After more than a century of experimenting with balloons—drifting and dirigible—some indifferent success has been achieved by flying machines and the over-sanguine members of the world perceive in the performance the beginning of universal aerial navigation. Some enthusiasts are already predicting that within a few years railroads and steamships will be rendered useless through the general introduction of flying machines. Railroad people have become so inured to the destruction of that business by the introduction of electrical methods of transportation that they are not likely to be much alarmed by the flying machine bogy. It is amusing to watch the contortions of the aerial navigation advocates, on small mercies coming their way after such long, tedious years of famine.

The first balloon ever tried was made at Annonery, France, in 1873, hot air having been the inflating medium. The performance excited much interest and it seemed as if a Balloon Age was imminent. After a great many costly experiments the active delusion subsided, but the French people always clung to the belief that their nation was destined to make aerial navigation successful. Railroad men are interested in experiments with baloons made about 1850 by Henri Giffard who endeavored to introduce a dirigible balloon. This required the use of a steam engine. Having had trouble with the water pump, Giffard invented the injector which afterwards became so popular for boiler feeding.

In spite of the existing furore about flying machines and dirigible balloons, very small success has been achieved with those modes of motion, considering the persistent attempts long carried on regardless of expense. Huge structures have been put together that carried considerable weight. These things could carry up masses of explosives that might be used for destructive purposes, but as a peaceful means of carrying burdens from place to place the dirigible balloon and the flying machine deserves to be classified merely as interesting playthings.

Diagrams of Mean Effective Pressure.

By Sidney C. Carpenter.

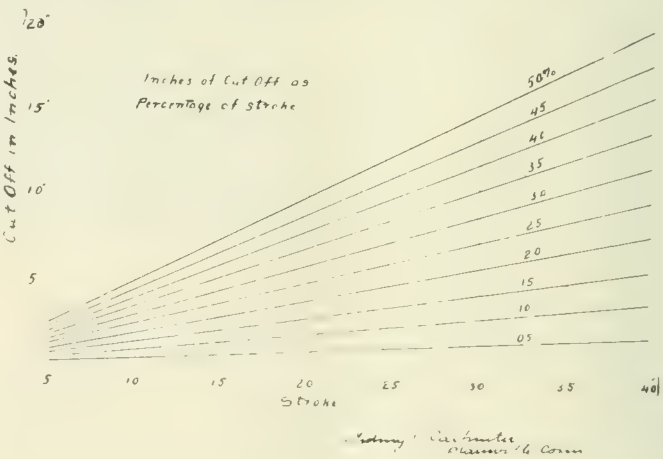
In locomotive design, as in any other machine design, you cannot get away from calculation, but the amount of work expended in solving problems depends largely upon the way you go about it. You may solve each problem as it comes up and do it all over again the next time it comes up, which is an unnecessary waste of time and energy and contains a large chance of error if the formula is complicated. This method may be improved upon by solving the formula for a number of conditions and placing the results in a table. Here you have the advantage of seeing the solution for a number of conditions at a glance, but if a problem comes up where the conditions are slightly different from those given, the calculation must be gone over again, or a guess made from the table; also each result in the table must be calculated separately.

A method which, to the writer, is better is to plot your results as the curve of a diagram. This means the least amount of calculation and it is done once for all, as the diagram will show by inspection the answer to any problem, with any combination of condtions, within its limits. In short, you can solve your problem forwards, backwards, and sideways, so to speak. A peculiar advantage of the diagram which is not possessed by a table is that it automatically points out any error in making it up, as you can see at once that the result is too far to one side or the other of the general line.

The calculation of the mean effective pressure in the cylinder will serve as an illustration of the construction and use of a diagram. The one in the illustration is calculated from the following table, which is taken from Sames's "Mechanical Engineering" and gives the mean effective pressure as an approximate percentage of the boiler pressure at different points of cut off.

Cut off.	Mean effective pressure.
1/8	.2 of boiler pressure.
1/4	.4
3/8	.55
1/2	.67
5/8	.79
3/4	.89
7/8	.93
Full stroke	1.00

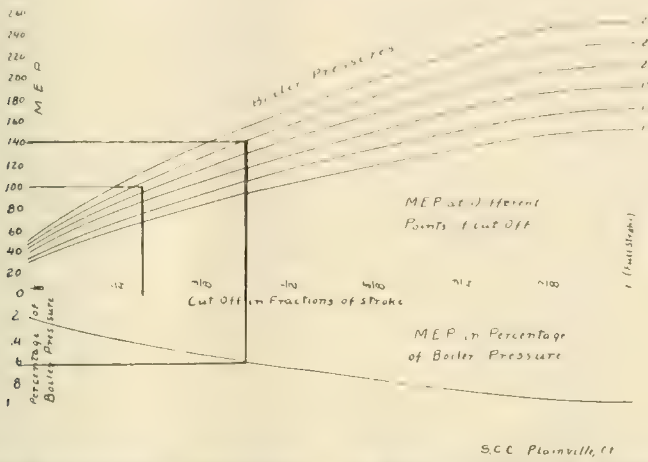
The table itself is plotted in the lower part of the diagram and the uper part gives its application to a number of problems. The lower curve is laid out as follows: On the horizontal line lay out the fractions of stroke; on the vertical line to the left consider every space as .1 of the boiler pressure and number the spaces to 1, which represents full boiler pressure. Now all the vertical lines on the diagram pass through the horizontal line which has just been laid out and represents points of cut off, while the horizontal lines, in the lower part of the diagram, represent parts of boiler pressure. From the table, or, say, in general, from the result of your calculation, the mean effective pressure at 1/4 cut off is .4 of the boiler pressure. Follow down on the vertical line from 1/4 till it meets the horizontal line from .4 and make a point. Do the same thing for the other results given in the table and you have a series of points passing across the diagram. Join these points by a line. Suppose steam is cut off at



INCHES OF CUT-OFF IN PERCENTAGE OF STROKE.

7/16 stroke and you wish to know the relation of mean effective pressure to boiler pressure. This point is not given on the table and in order to find it you would have to subtract .55 from .67, take half the difference and add it to .55. On the diagram you simply follow down from the 7/16 point till you reach the curve, and passing along the horizontal line you find the result to be a bit over .6 say .61, which is the same as you would get by the longer method from the table.

The upper part of the diagram shows the actual mean effective pressure for



BOILER PRESSURE PERCENTAGE OF MEAN EFFECTIVE PRESSURE.

different points of cut off and boiler pressures from 150 to 250 lbs. The curve for each boiler pressure is laid out in the same way as the lower curve, but the points are obtained by calculating the pressure from the fractions given in the table. As the line happens to be a curve a number of points were calculated to get the general direction. It often happens that the line is straight and only two points at the extreme ends need to be calculated, the points being joined by a straight line. It is well, in a case like this, to test by calculating one or two intermediate points to be sure they fall on the line.

With the diagram given, a number of problems can be solved. An engine has a boiler pressure of 230 lbs. What is the mean effective pressure when she is cutting off at 7/16 stroke? From the 7/16 point follow the vertical line to the 230 lb. curve and the horizontal line passing through the point of intersection gives 140 lbs. as the mean effective pressure.

An engine carries 225 lbs. What point of cut off will give an approximate mean effective pressure of 100 lbs? From the 100 lb. mean effective pressure point follow the horizontal line to a point about a qaurter of the way from the 230 lb. to the 210 lb. curves and then straight down. The cut off is found to be a little over 5/32.

Diagrams can also be used to find out what relations, if any, exist between different proportions of a locomotive. From the specifications of 25 eight-wheel types I laid out the total weights on a horizontal line and wheel weights on a vertical line and then plotted out the weight on the driving wheels and the weight on the truck for different total weights of engine. Taking two or three engines alone there was considerable variation in the proportions, the weight on the trucks or drivers sometimes even decreasing as the engine weight increased. For this reason the two series of points formed a couple of narrow bands, but the direction of these bands was such that a straight line could be drawn through the center of each from one end to the other. A series of these diagrams for different types of locomotives would furnish a rough approximation of the proper distribution of the weight.

Celebrated Steam Engineers.

XIII. JOHN ERICSSON.

The sixth day of October 1829, was a memorable day in the history of the steam engine. The directors of the Stockton and Darlington railroad in England were undecided in regard to the motive power to be used. Some advocated the continuation of the use of horses. Others were in favor of trying some form of steam carriage. Several eminent engineers suggested stationary engines, set at equal distances apart, operating a rope. A majority of the board finally decided to offer a reword of £500 for the best locomotive engine and prescribed a number of conditions as to weight, height, speed and tractive power.

It was a busy time among the engineers. Private trials of engines, some of them fearfully and wonderfully made, resulted in a selection of four contestants. Among these the "Novelty," constructed by John Ericsson, was the favorite. His engine was a well designed and finely proportioned machine. Ericsson had learned engineering in the Swedish army, and was a fine specimen of the stalwart Norsemen. The first trial of his engine surpassed anything in speed hitherto recorded, making over 30 miles an hour. Its weak point, the blowing apparatus with which it was equipped, vexatiously gave way at the crucial moment and the result was that Ericsson's "Novelty" succumbed to the superior stability of Stephen's "Rocket." The vital difference in the two engines was in the use of the exhaust steam as a draft appliance in the case of the "Rocket," as against the blower or bellows contrivance used in the "Novelty." It may be added that one of the competitors, the "Sanpareil" by Hackworth failed on account of the extreme intensity of its blast which caused the expulsion of unconsumed coal from the furnace while the "Perseverance" built by Burstall was found unable to attain the specified speed.

The high spirited young Swedish engineer, then in his twenty-sixth year, seems to have dropped the locomotive out of his further consideration. His mercurial mind ran into a hundred other channels. He invented a kind of rotary steam engine, and perfected the form of steam fire engine which, with little improvement, is now in universal use. He also invented a blower for marine boilers which was extensively used. In 1837 he produced a screw propeller which, although completely successful from the beginning, was very slow in being adopted by marine engine builders. In 1839 he came to America and became associated with Mr. Delamater, the eminent New York marine engine constructor. The introduction of the screw propeller progressed rapidly in America. Among Mr. Ericsson's inventions during this period was the caloric engine from which great things were expected. The press reports greatly exaggerated the performance of the caloric engine on its first appearance. Its construction was ingenious but its efficiency was extremely limited. In the atmosphere of American enterprise, Mr. Ericsson found ready encouragement, and although much of his work was not commercially successful, he kept on constantly working in new fields producing in rapid succession water meters, hydrostatic and steam gauges, instruments for measuring distances at sea, and among other forms of steam engine he built the first compound engine in use in the marine service.

His extensive experience and work in marine machinery culminated in the production of an armored warship equipped with a revolving turret which had the effect of completely revolutionizing battleship construction. There are few events more dramatic in history

than the appearance of Ericsson's "Monitor" during the American Civil War. The "Merrimac" a Southern gunboat on which some clever engineers had improvised an armor of rails rendering it invulnerable to the light guns used in the wooden ships of that time, had begun a career of havoc that bid fair to destroy the warships of the North. The two ironclads met at Norfolk Harbor, Virginia, on March 9, 1862, and not only was the career of the "Merrimac" speedily closed, but it may be truly said that every other wooden warship became useless, and the adoption of armored, turreted ships for fighting purposes became complete and immediate.

Great honor and good fortune came to Ericsson in his later years, but he seemed to care little for either. He took much pride and joy in his work. His great mental and physical strength seemed to abide with him to the last. At eighty-six years of age, shortly before his death, he was still at the drawing board twelve hours a day. Among the engineers of the nineteenth century few have equalled and none have surpassed the work of John Ericsson.

Questions Answered

COMPENSATED CURVES.

67. R. B. A., Port Huron, Ont., asks: What is meant by the expression a compensated curve?—A. This expression is used concerning a curve where there is also a grade. Suppose there is an up-grade on a tangent or straight line, and before the top of the up-grade is reached it is necessary to put in a curve. The resistance offered by the grade to the train would be greatly augmented if the same grade was continued through the curve. In order to keep the train resistance about equal to what it was on the grade, the grade would be made more level on the curve, and this flattening of the grade is the compensation for the curve. For light grades this compensation is not always necessary, but for heavy grades where a curve is necessary, a certain leveling of the grade is generally resorted to so that the train resistance will be about equal on the tangent grade and on the curve.

EASEMENT CURVES.

68. R. B. A., Port Huron, Ont., asks: What are easement curves on a railroad? —A. An easement curve is one interposed between a straight line and a regular curve so as to make the motion of the train more easy. A railroad curve is really part of a circle, and the straight portion of line is called a tangent. Suppose a 4 deg. curve was in the line between two tangents, the sudden change of direction would be too great for fast speeds and the proper elevation of the outer rail would be too abrupt if made exactly where the tangent and 4 deg. curve joined. At each end of the 4 deg. curve an easement curve is introduced, that is, a curve of greater radius, in order to shade off, so to speak, or ease down the sudden change of direction. In this case perhaps a short segment of a 1 deg. curve would be put in with gradual elevation of the outer rail. In this way a train passing from the tangent would first encounter a short 1 deg. curve, then the regular 4 deg. curve, after that a short 1 deg. curve and then on to the tangent.

DIFFERENT SIZES OF WHEELS.

69. L. C. B. Coomyton, Ky., writes: We have had quite a discussion and would be glad if you will give us your views through the medium of your valuable paper. We have three wheels mounted on and fixed to an axle, the two outside wheels are each two feet in diameter, while the center wheel is one foot in diameter. All wheels run on a track. The center wheel, on account of its smallness has the track built up to it. The question is, does not the small wheel have to slip on the track in order to keep up with the large wheels?—A. Yes, the small wheel slips on its rail. The distance between any two points on the track is the same whether measured along the high rail or along the lower rails. The rail measurements are all equal, but the circumference of a one foot wheel and of a two foot wheel are different quantities. In fact, the circumference of the larger wheels is just twice that of the smaller wheel. Here you have a fixed rail length, and two different circumferential lengths, and if the circumference of the large wheel measures out a certain distance along the track for one revolution, the smaller wheel, in one revolution can only measure out half that distance and it is compelled to slip the other half.

PUSHING AND PULLING COMPARED.

70. D. H., Toronto, Ont., writes: A car can be moved along a level line of railway about as easily one way as it can the other; why is it thought to take more power to push a train than to pull the same train?—A. There is more power consumed in pushing than in pulling a train. This can easily be demonstrated by the experiment of pushing and pulling a chain even in a well oiled and smooth straight groove. When the chain is pulled it comes along all right, but when pushed it has a decided tendency to buckle and its resistance to motion, when pushed, is much greater. The train of cars is in this respect like the chain, each car corresponding to a link, and when pushed the tendency of the train to buckle shows itself by increased flange friction against the rails.

TRIPLES AND RETAINING VALVES.

71. W. B. S., Princeton, Ind., writes, What objection can there be to using low release, say about 30 lbs., and dispensing with triples and retaining valves.—A You do not state in what class of service you wish to dispense with triple valves In view of the fact that the triple valve makes possible the operation of the automatic brake, we imagine there would be considerable objection to disposing of triple valves in a class of service severe enough to warrant the use of retaining valves.

The Modern Railroader.

Aspirants on railroads ought to look upon the business as permanent, and prepare themselves with the acquirement of knowledge relating to the work, the same way as lawyers, doctors and all classes of engineers prepare themselves for their future duties. When railroads were in the primitive stage, farmer youths, shopkeeper youths and all sorts of bright laborers entered railroad employment, and became satisfactory enginemen and trainmen, with a few months' experience; but railroading has become a more complex business than it was in those days, and better educated men are necessary for performing the more difficult duties. Early railroading was beset with difficulties and hardships that weeded out the unfit entrants very quickly. Railroading of to-day has nearly all the difficulties and hardships of old times, and has a great many new problems that can be solved properly only by educated men and students. The purely practical man who used to boast of his ignorance of book learning is very little in evidence now-a-days, and the man who understands the principles of his business and applies them properly, forges ahead of the whole tribe of know-nothings.

Discipline.

Discipline is a fine sounding word, but the action it describes is more often revenge than justice. Discipline properly defined, is the treatment suited to a disciple or learner. The definition put upon it by many petty railroad officials is, the privilege of inflicting punishment upon people who through ignorance, carelessness or design, violate rules. The more savagely the discipline can be inflicted the better it pleases the men who have no mercy in their souls.

The Lake Shore & Michigan Southern Railway between Buffalo and Chicago has been equipped with block signals. The distance is five hundred and forty miles, and the work has taken two years to do at a cost of about $1,500,000.

Air Brake Department

Care of the Air Pump.

By G. W. Kiehm.

When an engine arrives at the roundhouse with an air pump that has been neglected until it has broken down while in service the pump is sometimes repaired on the engine when it should have been removed, and sometimes it is removed when it would be more economical to repair the disorder and allow the pump to remain on the engine.

Each roundhouse has its own particular way of making repairs to a broken air pump, the air piston may come off the rod, and the repair man will put some kind of a clamp on the rod between the stuffing boxes to keep the rod from turning, run a die over the threads, turn the air piston upside down, cut a slot in the piston for the dowel pin, and tighten the nuts with a hammer and chisel, which is nobody's business but that of the company which allows it to be done.

There need be no exact time specified for the changing of air pumps if the roundhouse repair man is a man of experience and he can save the company many dollars spent on air pump repairs, by using good judgment as to when it is necessary to change the pumps.

If an up-to-date air brake man is employed and if his recommendations are given due consideration, he can, and is willing to be held responsible for the condition of the air pumps, and for air brake failures.

In order to keep the engine in service it is sometimes absolutely necessary to make repairs to the air pump while it is on the engine and the work should be done according to the length of time the pump is to remain on the engine thereafter.

For instance, if the air piston does work loose on the rod or if the nuts on the rod work off and the pump is expected to be in service for any considerable length of time the head must be fitted on the rod when the repairs are made; a patent lock nut should be used and if one cannot be obtained the threads should be blurred after the nuts are tightened.

To hold the steam piston from turning while threading the rod and tightening the nuts, the large end of the main valve cylinder cap can be removed and the main valve blocked in position to admit steam to the cylinder on top of the steam piston, by placing one of the 5/8-inch cap bolts between the large end of the differential piston and the cylinder cap and tightening the cap with the remaining three bolts, the cap nut should be taken off while doing this to prevent throttle leakage from blowing the differential piston and the slide valve out of the bushing.

The piston rod will then be held from turning by a force about equal to the boiler pressure multiplied by the area of the steam piston, and the threads would be stripped or the end of the rod twisted off before the steam piston would turn in the cylinder; if the rod does turn it is because it is loose in the steam piston.

If the air pistons of a duplex air pump work loose the pistons can be held at the upper end of the stroke by removing the reversing valve rod on the high pressure side and substituting one with the button broken off the end, and opening the pump throttle.

When the reversing plate is pulled off and the 9½ or 11 inch pump is located above the running board and very near to it, it is a difficult matter to pull or push the main piston to the upper end of the stroke, and the device which has been illustrated in these columns, page 170 of the April 1907 issue, can be used to pull up the steam piston and hold it.

When reversing plate bolts are put in, a piece of sheet copper, the width of the bolt head and long enough to turn up on one side of the bolt head and to extend over the plate to the steam piston on the other side, should be used, the strip of copper should have the bolt hole drilled in the proper place and be used as a washer, the bolt screwed down tightly upon it, and one edge turned up alongside the bolt head, the other down over the edge of the reversing plate, which will prevent the bolt from turning if it is pounded loose. This is a practical way of fastening reversing plate bolts and has prevented many pump failures, the copper can be handled nicely when annealed and being exposed to the steam in the cylinder will soon harden it again.

It may be customary to remove the air pump for inspection and repairs every six months, and shortly after renewing the pump the engine may spend three or four months in the shop, and when the pump is removed it may have given but two or three months' service and may be in as good condition as one just overhauled.

It would be a waste of time and material to change pumps under such conditions, and in a case of this kind the air and steam piston packing rings can be tested, an examination made of the reversing plate and bolts, and the top head. If the body of the pump is in good condition and the top head not entirely satisfactory no time would be lost in substituting a head known to be in good condition.

When the pump is removed for inspection and repairs it should be put in as good condition as a new air pump before it leaves the repair room. [illegible] have ideas of their own concerning the time when cylinders should be rebored and how the different parts should be fitted, and their methods are either economical or wasteful. It is a mistaken idea of economy to anneal imperfect gaskets and use them between the cylinders and the center piece, or to use stuffing boxes that should be scrapped.

Turning off the piston rod, using new valves with old seats and cages or with old bushings may represent the saving of a few cents on material in the repair room and cost dollars on the road and in the engine house, and the man who repairs the pump in the air brake room should by all means have some experience in the engine house first.

The repair man should follow as closely as possible the recommendations of the Air Brake Association, that only light repairs be made to air pumps on locomotives in the roundhouse.

If heavy repairs are required, such as tightening up piston heads, replacing steam valve apparatus, the pump should be removed from the locomotive and replaced with a tested pump known to be in good condition.

The association also recommends that the steam cylinder be rebored when the ends are 1/16 larger than the center of the bore, that the air cylinder be rebored when the ends are worn 1/32 larger than the center of the bore, and the air piston should be renewed when the diameter is 1/16 less than the bore of the cylinder.

The fit of the piston on the rod where the shoulder fit is used should be a light driving fit, where the rod is a taper fit it should be fitted to draw 1/16.

Piston packing rings for air and steam cylinders not to be used if the ring ends are 3/32 of an inch apart when placed in the end of the cylinder, and piston rods to be trued up when cut or worn 1/32 and "scrapped" when 1/16 below the standard size.

Threads on all valve seats, valve cages, tap screws and caps to be coated with a mixture of plumbago, or graphite, and oiled before being screwed into place, and steel air valves should be used for all air pumps.

In removing piston rod nuts, they should be cracked off to prevent the wear on the rod threads in screwing them off, and be

replaced with new beveled nuts that fit neatly on the threads of the rod.

In splitting off the nuts the chisel should be held in line with the rod to prevent the rod from being fractured, the air end of the rod and all bolts and tap screws should be annealed before again being placed in service which will prevent them from being fractured when tightening.

All air pump piston rods should be supplied with a good swab and kept well oiled and the air inlets of the pump to be supplied with a strainer, the area of which should not be less than five inches in diameter and located in such a manner as to be protected from rain, snow, steam or drippings.

It is also recommended that the air pump be located on the side of the boiler forward of the staybolts and to be securely fastened to the boiler with a cast steel or a cast iron bracket having true bearing surface for the pump after the bracket is secure to the boiler, brackets to have lugs cast on them to engage the lower end of the pump bracket to carry the weight of the pump.

When two pumps are used per locomotive both should be located on same side of the locomotive with one governor and steam valve to control both.

Undesired Quick Action.

The "undesired emergency," or quick action during a service application, is an annoying and dangerous disorder of the air brake, which, when it appears, is overcome for the time being only, to mainfest itself elsewhere later on.

As soon as the disorder is located and remedied, it is quickly forgotten, but while it is present all parties directly concerned are deeply interested and the undesired emergency is a very live topic for discussion.

The cause of this trouble is usually very easy to locate if it occurs frequently, or nearly every time the brake is applied, but if it only occurs occasionally, it is often very difficult to locate

Sometimes there is very little effort put forth to locate the cause of the disorder, and it is recommended that the triple valve be given more attention and more frequent cleaning, which may overcome the trouble.

If the undesired quick action is due to a sticky triple-valve piston or slide valve, a weak graduating spring, a broken graduating pin, or a sticky equalizing piston in the brake valve, an enlarged preliminary exhaust port, insufficient equalizing reservoir volume, or leakage from that volume, it is not difficult to detect the cause and apply the remedy, but if it is due to a number of defects or a combination of circumstances, each in itself unable to cause any undesired action of the brake, and when combined only cause the unusual action occasionally, it becomes a more difficult proposition.

A triple valve may be in such condition that it will work harmoniously among any number of others, provided that the brake valve reducing the brake pipe pressure is in good condition and that the brake pipe is reasonably free from leakage, while if there is a slight brake-valve disorder, the triple valve may be thrown into quick action occasionally during a service application.

A brake valve may be in such condition that the triple valves in a train of cars will be operated perfectly if they are in good condition, while if there is a slightly defective triple valve in the train it, in combination with the brake valve defects, will occasionally cause undesired quick action which would not have occurred had the brake valve been in good condition.

Disorders of this kind tend to lead to controversies, each party being right in their claims that the "brake valve is all right if the triples are" and "the triple valves were all right at the testing plant."

In this connection it may be well to advance the opinion that cars, especially freight cars, are here to-day and away to-morrow, while the locomotive is near a round-house or ash-pit every twenty-four hours, and there is consequently less excuse for defective air-brake equipment on a locomotive than on a car. The brake equipments on freight cars cannot be expected to be in perfect condition at all times, and very often a combination of defects tending to cause undesired quick action exist, the action of which can often be avoided by a correct manipulation of the brake valve.

As before stated in the columns of this paper, a light application of the brake on a train, or a series of light reductions, will bring about undesired quick action if that possibility exists in any of the triple valves in the train. This is one of the principal reasons why the light reduction is discouraged on short trains and trains of moderate length, as well as long ones.

The action or tendency of the light reduction is to draw the triple pistons against the slide valve gently, and if the slide valve in one of the triple valves sticks slightly, it may not be moved, and in cases of this kind the auxiliary reservoir volume cannot expand into the brake cylinder, nor through the feed groove into the brake pipe, owing to the movement of the triple piston; therefore the auxiliary volume remains bottled up until brake pipe leakage, or another light reduction creates sufficient difference in brake pipe and auxiliary reservoir pressures to dislodge the slide valve, at which time the piston will jump against the graduating stem and compress the spring, causing undesired quick action, which would not have been the case had the initial reduction been heavy enough to have drawn the piston against the slide valve with enough force to move it.

The triple slide valve's resistance to movement can be compared with the graduating spring's resistance to compression; they resist slow movements of the triple piston and yield to rapid or forcible ones. It is therefore evident that the triple pistons should not be allowed to move lightly against the slide valves either by brake pipe leakage or light reductions.

The light reductions can be avoided, and brake-pipe leakage as a general rule does not affect the triple pistons until the brake-valve handle is placed on lap position.

There is no necessity for placing the handle on lap position 15 or 20 seconds prior to the reduction, and allowing brake-pipe leakage to draw the triple pistons against the slide valves.

Brake-pipe leakage should not affect the triple pistons while the brake-valve handle is in running position unless the feed valve is sluggish or irregular, allowing brake-pipe pressure to vary; a feed valve in this condition may be one of the principal causes of undesired quick action.

When the disorder occurs and the cause is not promptly located, there are naturally many different theories advanced; sometimes the 10-inch equipment with the larger triple valve is blamed, the graduating spring may appear too light or the slide valve too large, creating too much frictional resistance, but if the investigations are continued long enough, the conclusions are almost sure to be "lack of care and maintenance," which is rational, for we sometimes forget that if the brake is maintained in good condition there will be no disorders.

While there may be more cases of undesired quick action at present, it should be remembered that there are also more triple valves in the train, consequently more opportunities for the disorder to occur.

The undesired quick action is in nearly all cases due to a combination of causes, for there is no disorder that will cause it under all conditions.

The broken graduating spring will not cause it on long trains; if the triple valve is sticky enough it will not move at all and under certain conditions the triple valve with a broken graduating pin will reduce the auxiliary reservoir pressure past the emergency piston to the brake cylinder, and quick action will not occur.

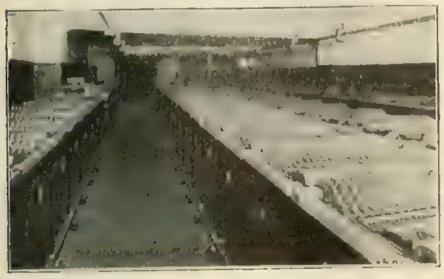
The undesired quick action is most serious when the train is parted by it, due to some disorder.

Electrical Department

Storage Bateries.

By W. B. Kouwenhoven.

Storage batteries are installed with certan definite purposes in view, and to obtain the best results a clear understanding of their care and operation is necessary. Storage batteries, unlike generators, engines and other central station machines, give no audible signs of trouble and almost no visible ones. They will continue to deliver current until severely injured. If the operator in charge of the station will remember that a storage battery will do so much, and no more, in a given time, that they deserve as careful treatment as a generator unit, and that any attempt to make them do more than they are designed for will only result in trouble, expense and dissatisfaction, then the storage battery will prove itself a very valuable asset to the equipment of the station.



STORAGE BATTERY ROOM.

CHARGE.

The rate at which the battery is to be charged is usually specified by the company furnishing the battery. The voltage necessary to start the charge is about 2.15 volts per cell. If this does not give the required charging current, the voltage must be increased until the proper current value is reached. Usually when charging a fully discharged battery, the current is raised about 20 per cent. above the normal rate; where it is maintained until the voltage per cell reaches about 2.5 volts, then the current is reduced to the normal rate and the charge is continued until the battery is fully charged.

At the beginning of the charge the voltage rises rapidly to about 2.2 volts per cell, and then very gradually to about 2.4 volts, the evolution of bubbles of gas begins at about 2.3 volts, this is known as gassing. From 2.4 volts as the charge continues the voltage rises to about 2.65 volts; at this point the charge is usually considered complete. If the charge be continued beyond this point, the voltage will rise as high as 2.8 volts per cell, although it is never advisable to do this in practice, except in case of badly sulphated plates which will be mentioned later. On opening the charging circuit the voltage falls rapidly to about 2.1 volts per cell.

In a station where it is not advisable to raise the voltage of the generator above that of the line, and no auxiliary booster is at hand for charging, it is necessary to divide the battery into sections in order to charge it. A battery which furnishes power to the line demands a voltage considerably in excess of that of the line to force the charging current through it successfully. In order to charge the battery it must be divided into sections, such that the line voltage will force the charging current through each section, thus they may be charged separately and afterwards united. In many central stations a machine called a booster is employed to raise or boost the line voltage across the battery, and thereby force the charging current through the cells.

There are two reliable methods of determining when a cell is fully charged; the one is to note the voltage of the cell, and the other the specific gravity of the electrolyte. Both of these methods are good, but the second, although more troublesome, is, in the opinion of the writer, the better. The specific gravity of a substance is the ratio of its weight per unit volume to the weight of pure water per unit volume. The weight of water per unit volume is unity. Thus a liquid of specific gravity 1.2 is 1.2 times as heavy as an equal volume of water.

The specific gravity of the electrolyte when the battery is charged is from 1.21 to 1.24 at 60 degs. F., although a specific gravity of 1.26 is often used for automobile work. The specific gravity is ascertained by means of an instrument called a hydrometer. The hydrometer is simply a sealed glass tube, weighted at one end. It sinks to different depths in liquids of different specific gravities, and a scale on the tube indicates the value in question.

DISCHARGE.

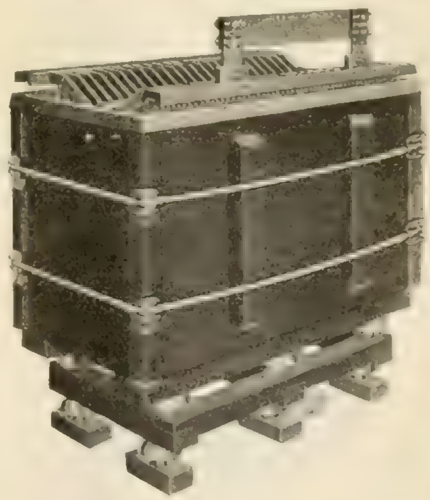
When discharging at the normal eight hour rate, the voltage drops rapidly to about 2.05 volts per cell, and within 10 or 15 minutes after beginning the discharge to 2.0 volts. From then on it continues to fall very gradually to a value of about 1.9, after which it falls very rapidly. The discharge should be stopped when the voltage reaches 1.8 volts, and under no conditions should it ever be allowed to fall below 1.75 volts per cell. The specific gravity of the electrolyte should never be allowed to fall below 1.15, and 1.185 to 1.195 is the general practice.

DESCRIPTION.

The plates in each cell of a storage battery are joined together by "burning" the plate terminals to a common bus-bar. This burning is simply a lead welding in which the heat of a blow pipe is used to weld the parts together.

The plates are then assembled in water-tight, acid-proof tanks or jars. Glass jars are usually employed for the small sizes, although rubber has come into use of late. Celluloid is employed to a great extent in Europe, but it has not found favor in this country. The large sizes of batteries, for central station use, are contained in wooden tanks, lined with sheet lead, with welded joints. A new type of containing cells is being put on the market which consists of glazed earthenware. These, if they prove successful will be permanent.

The containing cells or tanks accumulate a moist deposit of electrolyte due to the gassing, and to the creeping of the electrolyte. They are therefore



BATTERY CELL ON INSULATORS.

mounted on insulators and separated from each other.

Glass plates, about [illegible] of an inch in thickness are placed on opposite sides of the cell. The battery plates are supported by means of lugs, which rest on these glass plates and are thus prevented from touching the bottom of the cell.

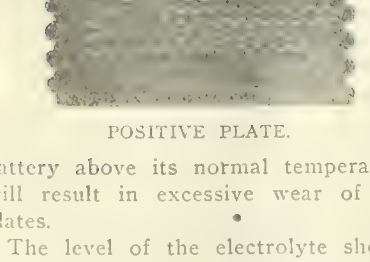
As alternate plates are at different potentials, some means of preventing

their coming into contact with each other is necessary. On the smaller sizes, glass lugs or perforated rubber sheets are employed to separate the plates. In the larger sizes glass rods are used to keep the plates in their proper positions.

It is a well known fact that the line voltage must be kept as near uniform as possible, and also that the voltage of a storage battery falls during discharge. Therefore some form of switch is necessary to vary the battery voltage before it is supplied to the line. These switches are called "End Cell Switches." The battery contains a sufficient number of cells to supply the full line voltage at the end of the discharge. When fully charged the total voltage of the battery is considerably in excess of the line voltage and fewer cells would suffice. During discharge, the voltage supplied to the line and the output are regulated by the so-called end cell switch, which serves to connect more cells in the circuit in proportion as the voltage of the individual cell falls. These switches are of either the automatic or the hand operated types.

CARE.

The effect of temperature on the efficiency, and the ampere hour capacity of the battery is very great. The temperature should never be allowed to exceed 100 degs. F. The temperature of a group of cells should always be measured near the center of the group. If the battery gives its full capacity at 70 degs. F., at 30 degs. it will give about 75 per cent. of its capacity, and at 90 degs. 112 per cent. The proper temperature of a battery is from 60 to 70 degs. F. Any attempt to operate a battery above its normal temperature will result in excessive wear of the plates.


POSITIVE PLATE.

The level of the electrolyte should be maintained about one inch above the top of the plates, and its specific gravity at full charge should be from 1.21 to 1.24, as was stated before. The specific gravity of each cell should be determined at least once every week. If upon testing the specific gravity of a cell it should be found to be less than that of the surrounding cells, it is generally due to local action or short circuit. The cause should be removed, and the cell should be disconnected and separately charged to bring it up to the condition of its mates. Never add acid to bring up the specific gravity until the cause of lowness has been carefully determined.

Water should be added from time to time to maintain the proper level. This water should be introduced into the tank at the bottom through a rubber hose; as the water will float on top, and not mixed with the electrolyte, if poured in, because the water is lighter than the acid.

During discharge, never exceed the one hour rate, and the discharge should never be maintained at this rate for more than twenty minutes. By one hour rate is meant the complete discharge of the battery in one hour. Never charge at too low a rate, as it is injurious, A thirty hour rate of charge should be a minimum.

If avoidable never allow a battery to stand discharged for any length of time. If impossible to start the charge immediately, stop the discharge at 1.85 volts per cell.

Be always on the lookout for sulphates. If the plates begin to show lighter, immediately locate the cause and remedy it at once.

Batteries should never be allowed to remain out of commission for any great length of time. A small charge and discharge should be given at least once a week. If the battery is to be put out of commission it should be fully charged then discharged at the normal rate for a couple of hours. The electrolyte should now be drawn off and the tanks filled with pure water. Then the discharge should be continued at one half the normal rate until the voltage falls to about 0.5 volts per cell. The plates should then be washed thoroughly and soaked in water for about 24 hours, after which they should be allowed to dry. Upon assembling the battery, add the electrolyte, give the battery a long over charge, and it will be in condition for use.

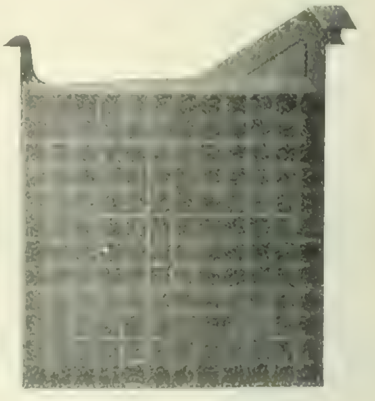
When the cells are deeper than two feet some means should be used to keep the electrolyte in circulation. A very good method is to lead a small rubber tube to the bottom of each tank. A current of air is delivered by the tube to the bottom of the tank, and the bubbles serve to keep the electrolyte in motion as they rise.

DISEASES AND THEIR REMEDIES.

The principal causes of trouble in a storage battery are:

1. Loss of capacity. 2. Fracture and buckling.

(1) Loss of capacity as distinguished from loss of charge is generally due to the clogging of the pores or loss of active material of the negative plate, or to the loss of electrolyte. When the negative plate shows a decreased capacity and exhibits no sign of sulphation it is generally found that the pores are clogged with sulphate or other impurities, or the active material has shrunken in volume. The remedy for this is to remove the plates and rejuvenate them by means of an electrochemical treatment and the use of dummy plates. They are finally converted back into sponge lead and replaced in the battery. The loss of electrolyte either by evaporation or otherwise should never be made up by the addition of water or acid. The mixture should contain about 95 per cent of water, the remainder being acid.


NEGATIVE PLATE.

(2) Fracture and buckling are due to excessive and unequal expansion of the active material composing the plates. This may be caused by the discharge being at too rapid a rate, or by its being carried too far. Buckling may even occur at the normal rate, due to defects in the plates themselves. If the buckling and fractures are due to the latter cause, there is no remedy. Care should be taken to see that the discharge is carried on at a normal rate and that the batery is not discharged below 1.85 volts per cell.

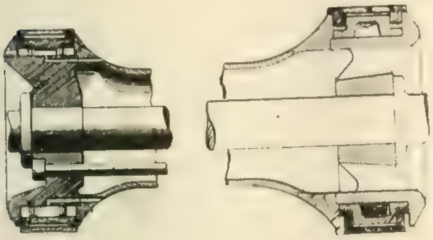
EFFICIENCY AND LIFE.

The efficiency of a storage battery depends principally upon the rates of charge and discharge, the internal resistance of the cell, its temperature and the condition of the electrolyte. The electrolyte spoken of all through this article is the name given by electricians to the liquid in which the plates are immersed, and it is this electrolyte or active liquid that attacks the positive and negative plates of the battery. A battery that is employed to regulate the voltage, and is charged and discharged in cycles of a few minutes each is known as a floating battery and has a watt efficiency of from 87 to 95 per cent.

Patent Office Department

PISTON AND PISTON-VALVE PACKING.

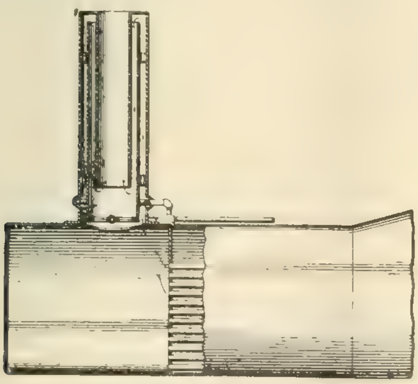
Two new patents have been secured by J. T. Wilson, Jersey Shore, Pa. Nos. 898,541 and 898,617. Both are in relation to packing for pistons and piston-valves. As will be seen in the accompanying illustrations the main features of the devices embrace a wide ring and two snap rings. In the drawing on the left side there are means for introducing steam beneath the snap rings and means for holding in parallel positions the inner portions or edges of the snap rings. The wide ring is expansible and wedge-shaped. There are also two non-expansible wall rings. The wide rings interlock the edges of the snap rings.


PISTON VALVE AND PACKING.

In the other device, also in combination with a piston or piston-valve, the packing comprises two expansible snap rings each being substantially in one piece, and a wide ring positively engaging the snap rings, having tongues and grooves. There is means also for introducing motive fluid beneath one of the snap rings.

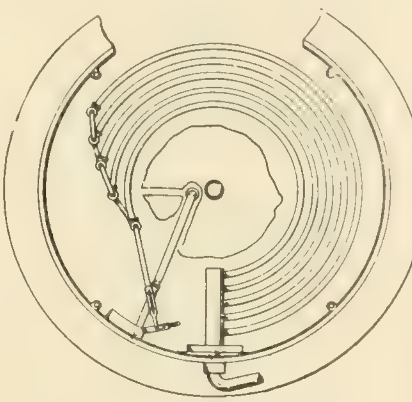
SPARKLESS SMOKESTACK.

A. Mathison, Rochford, S. D., has patented a sparkless smokestack for traction engines. No. 897,385. The device embraces a combination with a straight stack having at the top an inner annular flange, a depending sleeve carried by the flange, the sleeve opening upwardly and downwardly and ending near the lower end of the stack. There are brackets holding the sleeve in place, and a pipe is attached to admit steam into the stack. A damper is arranged in the lower end of the pipe


SPARK ARRESTING STACK.

PRESSURE GAUGE.

A pressure gauge has been patented by E. S. Wheeler, Detroit, Mich. No. 89,932. The device embraces in combination with a manifold, a plurality of co-axially arranged Bourbon tubes communicating therewith a rock shaft, links connecting the free ends of the Bourbon tubes to the rock shaft whereby the united action of the tubes is communicated to the shaft, and means actuated by the shaft for recording the movement of the tubes. The links have the effect of equalizing any irregularity of movement in the tubes.

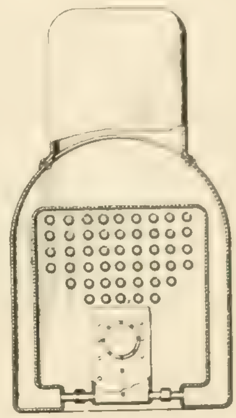

NOVEL FORM OF GAUGE.

DRAFT GEAR.

H. T. Krauka, Cleveland, Ohio, has secured a number of patents. Nos. 900,022 to 900,027 inclusive, in connection with draft gear and radial draft gear. In the former, the spring-rigging is carried by the car frame, and the drawbar is pivotally connected with the car-truck at a point back of the front end of the truck frame. In the latter there are telescopically fitted rods having at the outer end of each a member of a ball-and-socket joint. Much of the details of the various devices are not given in the Patent Office Gazette, but it may be stated that the inventor has assigned the entire series of patented inventions to the National Malleable Castings Company, Cleveland, Ohio

OIL-BURNING BAFFLE.

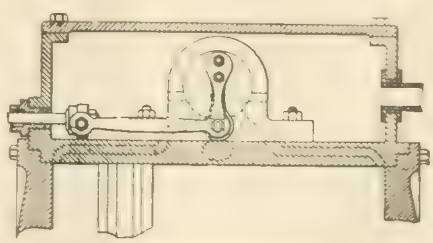
A baffle for oil-burning furnaces in steam engines has been patented by J. Emerick, West Medford, Mass. No. 898,662. The device has the form of a target for use in connection with a liquid fuel burner, a part of the wall of the target being made spherically convex to receive the direct action of the flame and spread it in all directions, the convex portion being made thicker than the remaining portion of the wall. There are struts bracing the target.


BAFFLE PLATE FOR OIL BURNER.

A recent press dispatch from Berlin states that Emperor William has invented a new hub and brake for railway trains and automobiles, which is described as offering the greatest possible guarantee against accident arising from the failure of existing brakes to operate when called upon. The practical experiments with it have not yet been completed.

ROTARY VALVE.

H. D. Snell, Maurglen, Pa., has patented a rotary valve for steam engines. No. 899.079. The device consists of a valve casing detachably mounted on a steam chest, a rotary valve held in the casing, a retaining and rocking member secured to each end of the valve there are rods connecting the rocker arms to the valve rod yoke.


ROCKING VALVE.

AMONG THE RAILWAY MEN

By James Kennedy

The repair shops of the Illinois Central at East St. Louis are a fine illustration of how the very best modern equipment may be well kept up under conditions that are not as new as they might be. The chief repair shops of the road are at Burnside, near Chicago, where over 3,000 men are employed. The shop at East St. Louis is a modernized roundhouse, originally intended for running repairs only, but now the large roundhouse has been cleverly subdivided with section and a repair shop, where the general repairing of three or four locomotives a month is completed and where ninety-seven locomotives are kept in running repair to a degree of perfection that leaves little to be desired.

Mr. Wm. McIntosh, the master mechanic, is a fine example of the younger school of master mechanics. He is making the most of the old roundhouse, and since taking charge of the shops, six months ago, he has already under way the installation of five electric motors, in place of the old stationary steam engine, for the purpose of running the different sections of the shops. There are already a number of electrically driven machines, including a wheel lathe of the newest type, which is doing excellent work. A feature of the work at present is the replacing of the axles of a large number of freight engines with a larger size of axle, the new size being 8½ ins., which is certainly necessary in view of the heavy loads drawn by the freight engines, the loads sometimes aggregating 2,500 tons.

A peculiar and constant cause of trouble among the switching engines at East St. Louis is the rapid wear of the wheel flanges. This is occasioned by the excessive number of sharp curves in the extensive yards. These curves were laid down at a time when the locomotives were less than half their present size, and while there is sufficient space in the flat lands of East St. Louis and vicinity to straighten these curves, it is next to impossible to secure the opportunity in view of the rapidly expanding volume of business. We were surprised to hear that many of the powerful six wheel switching engines required new tires every two or three months. The operation of re-tiring is simple and expeditious. The connecting rods are removed, the engine is slightly raised on blocks, worn tires taken off and the six new tires are heated and shrunk in position. There are no recesses or collars or binding bolts. In spite of the great [illegible] pressure in service the tires never [illegible] in their position.

A notable feature in regard to the removal of ashes has been installed by Mr. McIntosh. An ash pit constructed of sheet steel is nearly filled with water. The ash pans of the engines are emptied into this receptacle. The hot ashes are immediately quenched, and when the pit is fairly filled with ashes a movable crane with a clamshell bucket comes and readily lifts the ashes out of the pit into an ash car. The leaves of the clamshell bucket assume a vertical position in being lowered and close readily when being raised. The steel sheet composing the shell of the pit is perforated so that the water finally runs out, leaving the ashes comparatively dry. These is no hand work of any kind, other than the emptying of the ash pans of the locomotives into the pit.

An important feature of the works is the car department, which has extensive accommodations outside the old roundhouse. The methodical and orderly manner in which this usually complex section is arranged shows how thoroughly the subject has been mastered. There are over 300 men employed in this department alone, and in all there are between 500 and 600 engaged in the various departments of the works.

Mr. Wm. Kirkwood, the blacksmith foreman, very ably supplements the excellent work of the master mechanic. This section of the roundhouse is a model of neatness and it was readily seen that the method of utilizing old material spoke volumes for the economical management of the master minds of the busy establishment. We were pleased to note that the boiler shop is having a flue rattler established, made on the same principle as that in vogue at the chief shops of the company at Burnside, Ill. A raised platform furnished with an inclined plane permits of the flues finding their way unaided into the rattler, while a lower inclined plane is so arranged as to allow the flues to slide readily from the rattler on to a flat car, where they may be conveyed to the boiler shop at will.

The oil store room is furnished with every modern appliance, the oil is stored underground, and is constantly under heat and pressure. In the paint shop we observed several new feautres in the general work, one of which was the painting of gauge dials black, while the figures and pointers are painted white. It is claimed that at night this is a decided advantage, as in stray shadows, white dials somewhat browned or blackened do not contrast sufficiently with the figures and pointers.

Altogether there is a spirit of determination shown to make the most of the situation, and there is much that might serve as an example to larger establishments, and to crown all this it is particularly pleasant to know that the departments are on full time and full equipment, with no short hours and no suspended list. At East St. Louis good times have come back.

THE ST. LOUIS TERMINAL.

The St. Louis Terminal is something unique in the complex working of American railways, and no doubt if there is anything to be compared to it, either in the admirable plan or vast scope of its many details. Mr. Wm. Bawden, the master mechanic, and Mr. H. J. Pfeifer, the superintendent of maintenance, manage to keep the vast establishment in perfect working order. Indeed, nothing short of perfection would do under such conditions. It may be stated briefly that a score of railroads converge at this point, and the St. Louis Terminal Company have perfected a plan to manage the great passenger traffic incidental to a railroad center like this. Before approaching the great central depot, all passenger trains are taken in charge by the Terminal Company. There are 102 locomotives engaged in the work and about 250 engineers, as the locomotives are all double crewed and some even treble crewed, to meet the ceaseless traffic converging at this point. The depot consists of 32 tracks, and is in length sufficient to accomodate 15 passenger cars. The locomotives never enter the depot, as the cars are pushed into place. It would be idle to attempt to describe the endless system of signals. The 32 tracks raidate into innumerable and far-spreading branches and it seems as if there were miles of semaphores, an endless tangle surpassing human memory, and yet everything goes on like clock-work. The signals are all worked by compressed air, and the going and coming of the endless procession of trains are all indicated electrically in the signal towers. Nothing unexpected or unprovided for has ever happened during the fourteen years in which the vast plant has been in operation.

The mechanical appliances in use are of the best. The handling of coal, water and ashes, usually involving much hand work, is entirely managed by machinery. The mechanism in relation to this vast work is housed in a colossal structure resembling a coal-cracking plant in use at some of the

larger mines. Indeed, a portion of the work performed is the breaking of the coal into a size suitable for firing the locomotives. The most ingenious contrivance, perhaps, is the machinery in connection with the conveying of the ashes from the pits, beginning with the hopper-shaped carriages that run under the ash pans of the engines, and when filled glide noiselessly away on the rails which are set deep in the pits. At a certain point they are switched to an underground siding, where they are readily emptied into the buckets of an elevator, which in turn conveys the ashes to a height sufficiently great so that the buckets can be emptied into the ash cars stationed beneath. The coal is also elevated in buckets moved by an endless chain, and is not only cracked into proper size, but is cleaned and sifted and weighed and dropped quietly into the tenders of the locomotives. The sand heater and sifter and elevator is also in the same building, and the vast mechanism is so adjusted that one man can attend to the operating of the several separate involved devices.

BUILDING THE CONWAY BRIDGE.

Apart from the general machine repair shop, which is fitted with every modern appliance, the air-brake instruction department is the very best of its kind that we have seen. Mr. C. F. Smith, the instructor, has charge of the classes that meet at regular intervals. Every known appliance in use is in duplicate in the large class room. The duplicates are cut apart showing the internal position of the valves under the varying conditions, and the mechanical department is fortunate in having an instructor so qualified by education and experience as Mr. Smith. We were pleased to observe that a study of the complete set of charts published by RAILWAY AND LOCOMOTIVE ENGINEERING form a part of the curriculum of the air-brake class.

MISSOURI PACIFIC SHOPS AT KANSAS CITY, MO.

After a dull season of nearly a year the shops of the Missouri Pacific Railroad, at Kansas City, Mo., are rapidly taking on an air of activity. Restaurants are reopening in the vicinity, and the busy season is here already among the skilled artisans of the Missouri Pacific. Mr. W. C. Smith, Master Mechanic, although short handed for some time, has managed to keep the stock in good condition. He has installed a costly water purifying plant, the water in the vicinity being of a kind that is most pernicious to boilers. The results are very gratifying. It may be stated that Mr. Smith's methods of treating the water are not entirely new, but the mixture of ingredients as applicable to the varying conditions of the water is new, and the difficulty seems to be effectually met.

We observed a gasoline motor installed on the turntable, and in point of economy and efficiency it bids fair to find many imitators. On the important question of removing ashes, which seems to be a burning question with many of the master mechanics, a pit has been constructed between two tracks. An opening under the rails sloped inwardly toward the pit admits of a ready transference of the ashes to the center pit usually nearly filled with water. A movable crane with clamshell-shaped, self-closing bucket, rapidly lifts the ashes into the ash car. The central pit admits of the work being done while other engines are being cleared of their ashes, and with the proper amount of slope in the pits the scheme seems excellent.

There are nearly 150 men in the machine shop, and about 500 altogether in the various shops. About 40 locomotives are handled per day, and Mr. Smith manages to take in three or four of the larger locomotives for general repairs every month. The machine shop is not as large as it should be, but there is some talk of important additions at an early date. Mr. R. H. Cooper, the scholarly and gentlemanly chief clerk, expressed himself in the highest terms of praise on the educational work of RAILWAY AND LOCOMOTIVE ENGINEERING and claimed that in point of popular favor among the railway men of the Missouri Pacific, it surpassed all other publications of an engineering kind put together.

Cylinder Failures—A Probable Factor in Superheating.

BY F. P. ROESCH.

The alarming increase in cylinder failures in the past ten years has been a subject of quiet study on the part of mechanical men, on all railroads using modern high pressure engines. Such things as cracked saddle walls and plates, except in accidents, were comparatively unheard of in the older type of engine, while a split cylinder only occurred when the cylinder had been bored out below a safe margin.

The factor of structural strength or increased stresses was not lost sight of in the design of cylinders and cylinder-saddles on the modern locomotive, yet even with an increase in strength gained by the addition of reinforcing ribs, etc., the cylinder failures as compared to the older types of engine are as four to one.

In our later design all known stresses were amply provided for, and yet after from three to five years' service cracks would begin to develop in the saddle plates, steam or exhaust passages, bridges, etc., in a seemingly unaccountable manner and from no apparent cause. In our investigation we could form but one conclusion, that it was structural weakness, and therefore in our next order reinforced those points that had, by failing, given the impression that reinforcement was necessary.

Why should it be necessary to apply all this additional metal? We made our calculations from known factors and proved formulas in our first design, and allowed an ample margin for safety.

It has long been common knowledge that cast iron if subjected to a high degree of heat would permanently expand, and in expanding there would naturally follow a rearrangement of the molecules with a consequent reduction of tensile strength. The lowest temperature at which this expansion and loss of tensile strength took place, however, had never been definitely determined, neither was it known exactly to what degree the tensile strength of cast iron would be affected if continually exposed to a certain degree of heat for a period covering several years. It has remained for the Crane Company, of Chicago, to come forward with the first definite and reliable information covering the effect of ordinary steam temperatures on cast iron, after several

ENTRANCE TO CONWAY BRIDGE.

years' exposure. The results of their investigations and researches have demonstrated beyond a doubt that cast iron exposed to steam heat, whose temperature did not at any time exceed 575 degrees, decreased in tensile strength during a period of five years 49½ per cent. The percentage of loss in tensile strength at lower temperatures has not been definitely determined, yet there is no question but that it is proportional. The effect of heat being a slow, permanent, volumetric expansion, and a consequent weakened molecular structure. It was also found that the iron was affected in proportion to the percentage of carbon and silicon

content. It must be borne in mind that even though the total carbon and silicon content may be but 6 per cent. altogether by weight, they make up a much larger percentage of the metal when considered by volume as their specific gravity is but about 25 per cent. that of the metal iron. That is, in other words, if the carbon, silicon, sulphur, phosphorus and manganese in a 100 lb. cast iron cube total but 7 per cent. by weight, or 7 lbs. the metal iron itself will weigh 93 lbs., but by volume the 7 per cent. of impurities will occupy a space of about 36 per cent. of the cube, and the 93 lbs. of iron 64 per cent. When exposed to high steam temperatures the metal iron itself is unaffected, the high temperature acting upon the impurities only, and as these impurities take up 36 per cent. of the whole casting there is ample room for destructive action.

The above data was obtained by the Crane Co. from the bodies of 14 in. gate valves having walls ranging from 1¼ to 1½ ins. in thickness and flanges of 2¼ ins. thick, test bars about 10 ins. long being cut from the body of the valves tested.

While it is true that the cast iron valves on which the temperature effects noted were subjected to a somewhat higher temperature than obtains in locomotive cylinders using saturated steam at 200 to 225 lbs. pressure, yet when we take into consideration the fact that a locomotive cylinder is subject to continual and repeated shocks, to torsional stresses and strains, and that frequently when drifting and often when the engine is reversed the temperature of the cylinder is raised considerably above 600 degrees, is it not reasonable to assume that all these causes contribute materially to hasten the slow deterioration going on due to the temperature effects on the impurities in the iron?

Is this not the most reasonable hypothesis upon which to explain the apparently mysterious cylinder failures that have obtained since 200 to 235 lbs. of steam have become common?

Further, with the advent of superheated steam, is it not reasonable to assume that the destructive effects on cast iron will be hastened in proportion to the increase in temperature due to the added superheat, and that a decreased cylinder life will necessarily follow?

We believe the matter brought out is worthy of serious consideration, and that with the advent and adoption of superheated steam, the adoption of cast steel cylinders should be considered, as steel is not affected by moderate temperatures the same as cast iron, for the reason that the impurities are so small, both by weight and volume, that they may be disregarded, as even the small amount of carbon present being in the combined form, instead of existing as graphite, as it does in cast iron.

Making and Repairing of Frames.

A paper on this important subject was read at the recent meeting of the International Railroad Master Blacksmiths' Association by Mr. J. T. McSweeney of the Baltimore & Ohio. He spoke in part as follows: Making locomotive frames and repairing them has been the subject for a great deal of discussion on the part of the Master Blacksmiths' Association and the railroad companies of this country, and yet we have only commenced the one thing uppermost in the minds of the mechanical world, that is, to eliminate the breaking of frames and how to repair them cheaply when broken.

The B. & O. do not make any new frames at the company's shop at Garrett, Ind. Our work consists of repairing frames, and we do this in the smith shop or under the engine in the cheapest way we can. In the smith shop we handle our frames with a screw lift and an angle iron wheel around the frame. Two men can turn this frame. We use six men when making a weld. We make our welds with sledges and under steam hammer when we can. We make a V-weld with sledges, as I think the iron is driven together and not stretched as it would be if made under steam hammer. All welds on main frame rails are made with lap welds and V-welds. The lap welds we make, if possible, under the steam hammer; this gives a chance to see that both pieces have the proper heat before putting them together. With side heat on same you can be sure this weld is not going to break again in that place.

In making a fork weld or a V-weld the heats should be taken separate. It is a hard matter to draw the heat through to the center point of weld of this kind. I do not consider that this is a good weld. Welding on a pedestal jaw or leg to back of frame in this manner with separate heats and side heats makes a good weld, but it takes a great deal of time and labor to prepare this weld. It depends a great deal on the place the frame was broken as to how it shall be repaired.

I cannot say that I have changed my methods in making this kind of a weld since last year. I have put a good many new half pedestal jaws on frames under engines where end of frame for pedestal brace was broken off and have had success with all these welds. We spread frame with jack and a piece of iron with slot cut in one end and two wedges, driving the wedges from both sides. We do not have much trouble in getting them apart. We have made two welds of this kind in thirteen hours with three men. We build our furnace out of ordinary fire brick, with a hole for burner and a peep hole. Our furnace stands on three posts made from scrap flues or old pipe. We use hooks to pull posts from under furnace, allowing the bricks to drop into the pit. We use a small ram made in shape of a flater or face of sledge on the end of a bar, to weld up the inside of frame and weld up the outside with sledges. With the exception of the last weld I have used a bar of the same kind as I used on the inside. We use a heavy ram at the back end of frame to drive frame to length and find this is better than clamps, for so often you cannot get the clamps on in the right place; also, a jack to keep frame apart while taking heat. When heat is ready this jack is taken out. By doing this the heat reaches the center of frame.

Our furnace is built 4 ins. from frame to bottom of furnace and 3 ins. on top and sides. The burner is placed so the flame does not strike the frame, the flame passing under the frame, then around over the sides and top. We use crude and carbon oil, twelve to fourteen gallons, to make a weld. In this way there is no waste to the frame. By the time you have a heat and frame rammed to length, the frame is larger by a quarter of an inch all round than it was when you started to weld, the oil coming to the burner by gravity with 70 to 100 lbs. of compressed air. You must be governed by the length of your heat as to how much your frame will shorten.

The B. & O. R. R. has made a number of welds with Thermit this year at different shops along their line of road. There were two made at Garrett which have proved a success so far. Both engines had steel frames broken in different places. This class of engine has given a great deal of trouble in breaking main frame, being a cross compound. At first the frames broke over the first pair of driving wheels. The frames at this point on some of those engines have been increased from 4 x 5½ to 5 x 8 ins.; also some have new steel ends put on. The parts that have been increased have not broken. The cost of making one of those welds with Thermit was twenty dollars for material without any labor.

Will Use Electric Power.

The Interlaken-Lauterbrunnen-Wengern Alp-Grindelwald rack-and-pinion railway is in process of conversion to electric traction, and it is stated that the overhead trolley, with direct current, will be adopted. The line, which is nearly 15 miles in length, rises to a height of 6,700 ft. above sea-level. The conversion of this railway to electricity is being made because of cheap water power in the vicinity of the line. The torrents which flow down from the glacial areas in the mountains are utilized for power, and the snow capped peaks are covered by the "white coal of the Alps."

Items of Personal Interest

Mr. C. W. Tessiers has been appointed master car builder of the Mexican Central Railroad, vice Mr. John H. O'Brien, resigned.

Mr. E. M. Sweetman has been appointed master mechanic of the Southern Railway at Sheffield, Ala., vice Mr. W. F. Moran, resigned.

Mr. J. F. Casey has been appointed general foreman of the car department of the St. Louis, Brownsville & Mexico, with headquarters at Kingsville, Tex.

Mr. E. H. Harlow has been appointed master mechanic on the Atchison, Topeka & Santa Fe Coast Lines at Richmond, Cal., vice Mr. A. B. Todd, resigned.

Mr. F. E. Allen has been appointed road foreman of engines on the Iowa Division of the Chicago & North-Western Railway, with headquarters at Boone, Ia.

Mr. Robert E. Cameron has been appointed assistant road foreman of engines on the middle division of the Pennsylvania, with headquarters at Altoona, Pa.

Mr. W. A. George has been appointed master mechanic on the Atchison, Topeka & Santa Fe Coast Lines at Albuquerque, N. M., vice Mr. E. H. Harlow, transferred.

Mr. A. H. Shorth has been appointed district master mechanic on the Canadian Pacific Railway, with headquarters at Cranbrook, B. C., vice Mr. A. Hobkirk, transferred.

Mr. Wm. Geister has been appointed road foreman of engines for the Louisiana Division of the Chicago, Rock Island & Pacific Railway, with headquarters at Eldorado, Ark.

Mr. J. J. Evans has been appointed signal supervisor of the Chicago, Rock Island & Pacific at El Reno, Okla., with jurisdiction over the Choctaw and the Southern Districts.

Mr. G. E. Carson, formerly master car builder of the Pittsburgh & Lake Erie, has been appointed master car builder of the New York Central & Hudson River at West Albany, N. Y.

Mr. John Schrader, formerly night car foreman of the New York Central & Hudson River, has been appointed general car foreman of the car department, Mott Haven yards, New York.

Mr. G. M. Crownover, assistant master mechanic of the Chicago Division of the Illinois Central, has been put in charge of the Burnside shops, and his former position has been abolished.

At the recent convention of the Brotherhood of Firemen and Enginemen, held at Columbus, Ohio, Mr. W. S. Carter was elected grand master of the order. Mr. Carter comes from the State of Texas, having been born in Austin, Tex., on the 11th of August, 1850. He received a common school education, and his early days were spent on a cattle ranch. He began his railroad career as fireman in February, 1870, on the old Central & Montgomery Railroad, which is now a part of the Somerville Division of the Gulf, Colorado & Santa Fe Railroad. At that time on that road wood was used for fuel, valves and cylinders were lubricated

W. S. CARTER

through oil cups on the steam chest, and water was supplied to the boiler by pumps, the plungers of which were driven by each crosshead. While more modern devices had been introduced on some roads, their use had not yet extended to that section of the country. He served as fireman on the Central & Montgomery Railroad and on the International & Great Northern Railroad until 1888, except two years, which he spent in the baggage department of that road. Later he was promoted to the "right side," and ran a switch engine on International & Great Northern road for two years and six months, up to June, 1890. He next ran an engine on Denver & Berkley Park interuban road during the year 1890, and during the following year he took the position of engine dispatcher and extra engineer on the Monterey & Mexican Gulf Railroad. Leaving that road he took service as fireman on the Missouri, Kansas & Texas Railroad on the Houston Division from 1892 to 1894. His first appearance as one of the officers of the Brotherhood of Locomotive Firemen was in 1895, when he became editor and manager of the *Locomotive Firemen's Magazine*, a position which he held with credit to himself and satisfaction to his order for a period of eight years. In 1904 he was elected to the important post of grand secretary and treasurer of the Brotherhood, and this position he holds at the present time for, although elected to the office of grand master of the Brotherhood of Locomotive Firemen and Enginemen, he will not assume the duties of that office until January 1, 1909. Mr. Carter's career is one marked by energy and perseverance, and his thirteen years of active participation in the chief councils of his order has given him a wide knowledge and varied experience of men and of large affairs which not everyone is fortunate enough to obtain. He has now, by election to the chief executive office of the Firemen's Brotherhood, received an encouraging and well-deserved expression of confidence from the members of the large and important organization of which he will shortly be the head. Mr. Carter has always wielded a strong influence in shaping the policy of the order and the firemen and enginemen may confidently look forward to a continuance of the wise policy, the maintenance of which has rendered that body respected wherever its name is known.

Mr. A. H. Powell has been appointed master mechanic of the Denver & Rio Grande at Salt Lake City, Utah.

Mr. Chas. Hattery, signal supervisor of the Kansas Division of the Chicago & Alton, with offices at Topeka, Kans., has been given jurisdiction over the El Reno and the St. Louis Divisions.

Mr. J. T. Carroll, assistant master mechanic of the Lake Shore & Michigan Southern at Elkhart, Ind., has been appointed master mechanic of the Lake Erie & Western at Tipton, Ky.

Mr. A. Hobkirk, formerly master mechanic on the Canadian Pacific Railway at Cranbrook, B. C., has been appointed train master on the same road with headquarters at Medicine Hat, Alberta.

Mr. Wm. Daze, formerly road foreman of engines, has been appointed mas-

ter mechanic on the Atchison, Topeka & Santa Fe Coast Lines, at Winslow, Ariz., vice Mr. W. A. George, transferred.

Mr. G. W. Daves, signal inspector of the Chicago & Alton, has been appointed signal engineer of the Chicago & Alton, and of the Toledo, St. Louis & Western Railroad, vice Mr. Wm. Daves, resigned.

Mr. A. R. Ayers, formerly assistant superintendent of shops of the Lake Shore & Michigan Southern, has been appointed assistant master mechanic on the same road, with headquarters at Elkhart, Ind.

Mr. W. Mills, formerly car foreman in charge of the Algoma Central & Hudson Bay Railway car shops, has been appointed master car builder on that road, with headquarters at Sault Ste. Marie, Ont.

Mr. C. C. Reynolds has been appointed road foreman of engines of the Albuquerque Division of the Atchison, Topeka & Santa Fe, with headquarters at Winslow, Ariz., vice Mr. Wm. Daze, promoted.

Mr. W. J. Hoskin, formerly master mechanic of the Chicago Great Western Railway at Des Moines, Ia., has been appointed master mechanic of the Chicago & Alton, with headquarters at Bloomington, Ill.

Mr. A. Binns, formerly locomotive engineer on the Canadian Pacific Railway, has been appointed acting road foreman on the O. & Q. division of the same road during the absence on leave of Mr. L. G. Roblin.

Mr. T. F. Barton has been appointed master mechanic of the Morris and Essex Division of the Delaware, Lackawanna & Western Railroad, with headquarters at Kingsland, N. J., vice Mr. A. C. Adams, resigned.

Mr. C. H. Osborn, formerly master mechanic of the Chicago & North-Western at Baraboo, Wis., has been appointed assistant superintendent of the car department on that road, with offices at Chicago, Ill.

Mr. S. E. Kildoyle has been appointed master mechanic and master car builder of the Vera Cruz & Isthmus Railroad, with headquarters at Sierra Blanco, V. C., Mex. He has charge of all shops, equipment and motive power.

The three following gentlemen were appointed members of the Canadian Railway Commission as provided for in the legislation of last session: Hon. Thomas Greenway, Mr. D'Arcy Scott, K. C., and Mr. Wm. Galliher, M. P., for Kootenay.

Mr. R. V. Hogue, assistant master mechanic of the Denver & Rio Grande at Salt Lake City, Utah, has been appointed acting master mechanic on that road, vice Mr. A. H. Gairns, resigned.

Mr. C. R. Robinson, formerly sales agent for the Inland Steel Company of Chicago, resigned October 3d to accept the position of Chicago representative for the Lackawanna Steel Company, under the title of District Sales Agent, with offices in the Commercial National Bank Building, Chicago.

Mr. Chas. T. Derrick has been promoted from assistant road foreman of engines on the middle division of the Pennsylvania to road foreman of engines on the Pennsylvania and Northwestern division at Bellwood. He entered the service of the Pennsylvania as a freight brakeman on December 27th, 1887.

Mr. F. Sutherland, who for the past fifty-one years has held the position of master car-builder for the Eastern Division of the Grand Trunk Railway, at Montreal, Que., was lately made the recipient of an illuminated address and a handsome gold watch and chain. He retired from active service on a well-earned pension.

Mr. William Miller, who recently gave up the position of superintendent of motive power of the Western Maryland Railroad owing to ill health, has lately become connected with the Adreon Manufacturing Company, of Chicago. This concern, which deals in general railroad supplies, has been re-organized with Mr. E. L. Adreon, Jr., as president, Mr. Wm. Miller, vice-president, and Mr. D. N. Niederlander, secretary-treasurer.

Mr. Joseph Boynton, of Chicago, a locomotive engineer on the Alton, has just passed his 64th birthday and celebrated with it his 50th year of service with the railroad. In 1858 he began as a messenger boy at the Chicago station and in 1864 was made a locomotive engineer. Since 1874 he has been handling trains at the Brighton Park switchyard at Chicago. He is in the prime of health and bids fair to spend many more years at his employment.

Mr. W. R. McKeen has been appointed a consulting engineer on the Union Pacific Railroad.

Mr. William L. Reid, formerly superintendent of the Schenectady works of the American Locomotive Company, has been appointed manager of the same works, vice Mr. James McNaughton, promoted. Mr. Reid began his work in the shops of the Rogers Locomotive Works and worked his way up to be assistant superintendent. From there he went to the Brooks Locomotive Works at Dunkirk, N. Y., as superintendent, and later he returned to the Rogers Locomotive Works as superintendent. When the American Locomotive Company took over the shops Mr. Reid was transferred to the Schenectady shops as superintendent, and on October 15th, 1908, was appointed manager of the American Locomotive Company's Schenectady plant.

Mr. P. H. Morrissey, grand master of the Brotherhood of Railroad Trainmen, has been chosen as president of the American Railroad Employees' and Investors' Association, the organization recently launched by capital and labor for the purpose of combating legislation hostile to the railroads and creating a more friendly public sentiment. Besides Mr. A. J. Earling, president of the C. M. & St P., the executive committee is composed of Messrs. B. L. Winchell, president of the Rock Island; E. P. Ripley, president of the Santa Fe; George B. Harris, president of the Burlington; A. B. Garretson, grand chief of the Order of Railroad Conductors: John J. Hannahan, grand master of the Brotherhood of Locomotive Firemen and Enginemen; Warren S. Stone, grand chief of the Brotherhood of Locomotive Engineers, and Mr. Morrissey.

At the recent meeting of the board of directors of the American Locomotive Company Mr. James McNaughton was elected a vice-president of the company and appointed manager of the sales department, with headquarters in New York, vice Mr. R. J. Gross, resigned. Up to the time of his promotion Mr. McNaughton was manager of the Schenectady works of the company. He was born in August, 1859, at Queensville, Ont., Canada. Previous to beginning railway work he served an apprenticeship of five years as a machinist, beginning in 1873. He entered railway service 1880 as machinist, in the employ of the Chicago & West Michigan Railway, after which he was consecutively, 1880 to 1882, machinist on the Minneapolis & St. Louis Railway, and on the Northern Pacific at Brainerd, Minn.; later he became a gang boss on the same road and passed through the several grades of machine shop foreman, general foreman and master mechanic of the Montana Division of the same road. From May, 1890, to April, 1894, he was superintendent of motive power of the Wisconsin Central. Later he was also given charge of the car department of the same line. On June 30th, 1898, he became general superintendent of the Brooks Locomotive Works at Dunkirk, N. Y., now controlled by the American Locomotive Company. In January, 1903, in the service of this company; he was moved to Schenectady as general superintendent of the Schenectady works, and later he became manager. His wide mechanical experience, coupled with his extensive railroad acquaintance, makes him particularly well fitted for the high position to which he has just been appointed. It is a position probably next to that of president in point of importance and Mr. McNaughton's selection for the post is a striking tribute to his ability, energy and judgment. His wide circle of friends wish him every success in his new field of labor, and RAILWAY AND LO-

comotive Engineering joins the others most heartily in congratulations and best wishes.

Mr. Robert J. Gross, formerly vice president of the American Locomotive Company, in charge of the sales department, tendered his resignation as the head of that department to the board at their last meeting. Mr. Gross' resignation was a voluntary act and was received with regret by the company. His retirement from active work is owing to the pressure of his many private interests to which he now intends to devote his time. Mr. Gross, however, remains on the board of directors of the company. Mr. Gross comes from the land of the Maple Leaf, having been born in Brighton, Ontario, in 1850. At an early age he entered the service of the Montreal Telegraph Company, and was several years in their employ. Later he turned his attention to the more responsible duties which come with railroad work, and after having been a station operator for some time, he was advanced to the position of train dispatcher while yet a youth of nineteen years, in the service of the Erie Railroad at Buffalo and at Dunkirk. In 1879 he became chief dispatcher on the Denver & Rio Grande, at Pueblo, Col., and that company soon made him manager of transportation, in which position he remained until he again accepted service with the Erie in 1881. In 1882 Mr. Gross became associated with Horatio Brooks, the founder of the Brooks Locomotive Works, at Dunkirk, N. Y. He was Mr. Brooks' chief assistant and showed marked ability as a salesman for that company. The Brooks Works advanced Mr. Gross through several important positions until he was elected vice-president of the company, and as such he remained until 1907, when the Brooks Works were absorbed by the American Locomotive Company, and he was then elected to the 2d vice-presidency of the larger concern. He remained in Dunkirk until called upon to become vice-president and the executive head of the sales department. Mr. Gross intends to make his home in Dunkirk, N. Y., and leaves the active work of his department followed by the best wishes of the company he has so ably served, and by all who have come in contact with him.

Harry Lauder.

When a working mechanic, laborer or workman of any kind through natural ability, push, energy and perseverance, succeeds in raising himself to a prominent position in life, we are always ready to tell his story for the benefit of the numerous lowly readers of Railway and Locomotive Engineering. The advice, go thou and do likewise, has encouraged many of our readers in the past, who were striving to make their way in the world.

Our latest workman hero is Harry Lauder, a Scottish comedian who has been amusing immense audiences in the British Isles, and in a few American cities. Mr. Lauder is the most popular entertainer alive, and it is difficult to point out his equal among the artists of the past. As a singer of catchy, amusing songs, and as a recounteur of funny stories, as an exponent of melody and mirth, Harry Lauder is unequalled. He must be heard to be appreciated.

When Harry was about twelve years old, his father died, leaving the mother with seven young children unprovided for. It is an old story. Every child who could earn a penny had to work. Harry entered one of the linen mills in Arbroath as a half-timer, earning two shillings (50 cents) a week. Even as a boy engaged in that luxurious employment, Harry's musical genius aserted itself, and he gained the first prize, a watch for singing at an amateur concert.

Soon after that the mother moved with her family to Hamilton, a coal mining district, where Harry obtained employment as assistant to a .miner The drudgery of of the miner's life suppressed Harry's musical aspirations for a few years, but they asserted themselves in the end, and emancipated their owner from the most prosaic species of toil.

The Scottish church people have a strong predilection for "soirees," the church festival of America, where entertainment of the cheapest kind is dispensed. The usual recompense for singers, was a cup of tea and a cookie. Harry Lauder was so popular at these soirees that he was paid five shillings for singing at a concert, which he thought a fortune. Regular engagements followed; he took part in several singing tours, but twice returned to the mine for want of concert employment. But he was making his way, and eventually achieved a great success in London, where he has had for years permanent engagements. A few months ago he was invited to entertain a party where King Edward was present and was highly praised by His Majesty.

Mr. Lauder has been greatly helped in his career by an excellent wife who was always encouraging her husband in his aspirations. She has always kept pace with his upward movements.

Last Fall he filled a short engagement in New York, and was this year engaged again in the same city at a salary of five thousand dollars a week. He is author of an asortment of popular Scottish songs, that are the delight of music halls, but nowhere so attractive as when sung by the author.

All his songs are accompanied by monologue. One of his latest [illegible] Sandy's father [illegible] gone to the Highlands to [illegible] Country. [illegible] wi' a terrible railway accident [illegible] he [illegible] baggage."

"How did it [illegible]," [illegible] the mother, anxiously.

"The cork came out o' the bottle," said Sandy's father.

Fuel Agents Seek to Organize.

An organization committee, [illegible] it may be called, made up of men connected with the fuel departments of railways, has lately got together in Chicago, and have issued a call to purchasing or fuel agents, fuel supervisors, fuel accountants and chief clerks to heads of fuel handling departments. The idea is to form an association, social and educational, for men engaged in the purchase, distribution, handling and accounting of fuel on the railroads of the United States, Canada and Mexico.

The proper method of handling, inspecting, weighing, distributing and accounting for fuel, together with the most approved manner of handling coal and oil from cars to engines, suggests an ample field for discussion that cannot be other than fruitful of benefit to the employer and the individual. The organization committee consists of these men: Eugene McAuliffe, chairman, General Fuel Agent, Rock Island-Frisco lines, Chicago, Ill.; R. L. France, Fuel Agent Southern Pacific, San Francisco, Cal.; C. H. Macklin, Purchasing Agent, Seaboard Air Line, Portsmouth, Va.; J. R. Rooks, Fuel Agent, Boston & Maine, Boston, Mass.; J. H. Hibben, Fuel Agent, Missouri, Kansas & Texas, Parsons, Kan.; Thos. Britt, General Fuel Agent, Canadian Pacific Ry., Montreal, Canada; S. L. Yerkes, Fuel Agent, Queen & Cresent System, Lexington, Ky. The meeting for which the circular issued by the committee paves the way is to be held in the Auditorium Annex Hotel, Chicago, on Friday, November 20, next at 10 o'clock in the forenoon.

Obituary.

Mr. Robert Miller, general manager of the Caledonian Railway, died in Glasgow, Scotland, on the 18th of last month, at the early age of 58 years. He was one of the most genial and lovable characters in the railway world. A story teller, a Sunday school teacher, a man of distinguished appearance, he arrested attention, and was received with delight wherever he went. He rose step by step in the railway service, from a clerkship in the freight department in 1873, and filled almost every intervening place until his appointment as manager in 1901. He was an example in sincerity, uprightness, and loyalty to the highest ideals of the railway service.

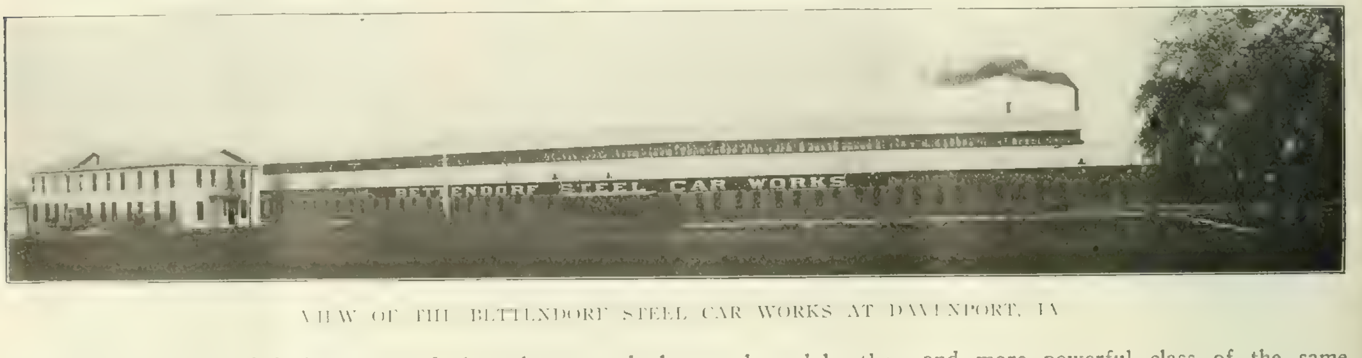
A Modern Steel Car Plant.

The shops of the Bettendorf Axle Company, one of the progressive industrial concerns engaged in the manufacture of car equipment and the building of all-steel cars, have been gradually extended in the past few years to enable the company to handle their growing business. The new site at Bettendorf, a suburb of Davenport, Iowa, covers an area of 70 acres. The carefully planned layout of the shops and the arrangement of buildings and tracks greatly facilitates the operation of the plant.

The main shop is a building 700 x 240 ft. floor area, contains perhaps the most complete hydraulic plant in the country. All, or nearly all, of the shaping of the car parts is accomplished by the aid of hydraulic presses, of which there are upwards of sixty, varying in capacity from 50 to 1,800 tons. Some idea of the power developed can be gained when it is stated that in the largest of these presses 24-in. I-beams are shaped cold. That is, the ends are reduced and the beam is otherwise shaped and punched in various places without being heated. All the smaller car parts, except the castings, are shaped and prepared for use in the same way. The special hydraulic machinery used in this plant was designed and built by the company.

Aside from the hydraulic machinery, the works contain a full equipment of tools operated by electric power and by compressed air. There are eleven traveling cranes of varying capacity, which are electrically operated and enable the rapid assembling of the car parts.

Much of the riveting work, and particularly that of the sheets, is done by compressed air tools, and this power is



VIEW OF THE BETTENDORF STEEL CAR WORKS AT DAVENPORT, IA.

also made use of in finishing most of the cast parts. An air-operated sand-blast apparatus is used for cleaning the sheets and other parts of a car preparatory to painting.

The operation of the main shop is from east to west. The hydraulic presses are in the east end, where the bolster and car parts are shaped and punched. The car and bolster riveting departments are in the west end of the shop. Castings are brought from the storehouse south of the main shop, and carried to the center of the shop, where they are riveted to the steel bolsters and to the car parts. The body and truck bolsters, steel underframes and all-steel cars are assembled, painted and shipped from the west end.

Immediately south of the main shop is the power house, 80 x 220 ft., part of which until recently was utilized as a machine shop. The power house supplies electricity for lighting the shops, office building and yards, as well as operating the electrically driven machinery. Six horizontal boilers, with an aggregate capacity of about 1,000 h.p., are in the west end of the building, and the engine room adjoining contains the pumps and other machinery.

Still further to the south and east are the storehouses for the material, covering an area of several acres, and to the west is the paint shop and other minor buildings, in a group by themselves. The D. R. I. & N. W. Ry., the C. M. & St. P. Ry. and the C. B. & Q. Ry. run through the manufacturing tract, and excellent switching and yard facilities, including four tracks, running through the main buildings, have been obtained. Locomotive cranes facilitate the loading of materials in the yards and shops.

The machine shop, as has been stated, was until recently located in the power building, but the available space proving entirely inadequate for the purpose, it was last fall decided to erect a new machine shop directly east of the power house and south of the main shops. The new machine shop is a building 50 x 380 ft., of which the west 80 ft. will be utilized for a blacksmith shop, leaving the size of the machine shop proper 50 x 300 ft.

The office building of the company has also recently been enlarged by the addition of a second story, which gives more room for the increased clerical force.

To give an idea of the progress made by the Bettendorf Company in the manufacture of railway equipment, it may be stated that, starting about ten years ago with the production of the I-beam bolsters in the old Davenport plant, there has since been added the manufacture of the Bettendorf steel car underframe, the cast-steel truck, with integral journal boxes, and finally, complete tank and freight cars. Of the bolster there are now over half a million in service, and the Bettendorf ideal car truck with the one-piece frame is being adopted by many of the leading railway systems of the country. The tank cars of the Bettendorf type have been furnished to upwards of forty private car lines, and with the present year the manufacture of complete freight cars on an extensive scale was commenced. Just recently these shops turned out an order for 1,000 gondola cars for the C. B. & Q. Ry. An account of this type of car was given in the June issue of RAILWAY AND LOCOMOTIVE ENGINEERING, page 264, and at the present time an order for 2,500 steel underframes for the Chicago, Milwaukee & St. Paul Ry. is going through the works at the rate of about 25 per day. To give a further idea of the capacity of the plant at the present time, it may be stated that it can turn out 25 complete cars or forty steel underframes in a day, and further contemplated improvements will largely add to this capacity.

Ten-Wheeler for the Lackawanna.

For several years the standard class of heavy fast passenger power on the Delaware, Lackawanna & Western Railroad has been the ten-wheel type of engine and their equipments represents a steady progression in size and weight, until at present, it includes some of the heaviest engines of this type in the world. The first ten-wheel engines designed particularly for fast passenger service built for this road were 7, turned out by the Brooks Works in 1900. In 1905 a heavier and more powerful class of the same type was introduced, five of which were built by the Schenectady Works of the American Locomotive Company. From 1905 until 1907 this last class remained their standard design of heavy high speed ten-wheel engines; when it was superseded by another design with the same size cylinders and tractive power, but equipped with piston valves and Walschaerts valve gear. These changes in

the design somewhat increased the weight of the engine, and an order of seven of this design was built at the Rogers plant of the American Locomotive Company.

Recently the Schenectady Works of the same company completed an order for eight simple engines of practically the same design as those built in 1907, except for the arrangement of the Walschaerts valve gear. These engines, which are illustrated in our half tone engraving, have a total weight in working order of 217,000 lbs. and are, to the best of our knowledge, the heaviest ten-wheel engines in the world. The cylinders of these engines are 22½ x 26 ins. and the driving wheels are 69 ins. in diameter, and with a boiler pressure of 215 lbs. the calculated tractive power of the engine amounts to 34,800 lbs. The rigid wheel base is 14 ft. 4 ins., while the total wheel base is 25 ft. 6 ins., with the tender added the length of the wheel base comes up to 55 ft. 1½ ins. The driving wheels carry a load of 171,000 lbs, out of the total of 217,000 lbs., thus leaving a weight of 46,000 lbs. on the engine truck. The driving axle load is here 57,000 lbs.

The valve gear, which is the most interesting feature of the design, is one of the builders' latest arrangements, and is an excellent example of a light and simple design of this type of gear. It differs principally from the arrangement employed on the previous class, in that the radius bar, instead of being directly connected to the reverse shaft arm by means of a slip block, is connected to a backward extending arm of the reverse shaft by means of a link. Following the now almost universal practice where the Walschaerts valve gear is used, the centers of the valve chambers are placed outside of the center of the cylinders so as to bring all the parts of the gear more nearly into the same vertical plane and thus obviate the necessity for the use of rocker arms to transmit the motion of the link to the valve stem. In the engines under consideration, the valve chambers are offset 4 ins. so that the centers of the links are only 3 ins. outside of the center of the valve stem. The link which is of the built up type is carried by a specially designed steel casting which is bolted to the front of a crosstie, located between the first and second pair of driving wheels and extending outside of them. A longitudinal steel plate located outside of the forward driving wheels and secured at the front end to the guide yoke and at the back end to the special crosstie, before mentioned, furnishes a support for the reverse shaft bearings which are bolted to it about 9 ins. ahead of the center of the link support. As the valves are inside admission, the radius bar is connected to the combination lever above the valve stem connections. The valve stem is directly connected to a small crosshead which slides on a suitable guide, supported between the valve chamber head and the guide yoke, and the combination lever is connected to this crosshead making a very satisfactory and rigid design. The Engine frames are of cast steel with double front rails and are 5 ins. wide. All the driving wheels on a side are equalized together by means of an equalizer beam between the first and second pair of drivers and an inverted leaf spring between the second and the third pairs.

The boiler is of the wagon top type, radially stayed, with wide fire-box for anthracite coal. The inside diameter of the boiler at the front end is 73 ins. and the barrel is made up of two courses. There are in all [illegible] tubes, 15 ft. [illegible] long, providing a heating surface of [illegible] sq. ft., the total heating surface of boiler being 3,387 sq. ft. The firebox is 108[illegible] ins. wide, 126[illegible] ins. long and has a heating surface of 22[illegible] sq. ft. and a grate area of 10[illegible] sq. ft. This gives a ratio of one square foot of grate to about [illegible] sq. ft. of heating surface in the boiler. Flexible staybolts have been very liberally used throughout the breakage zone, as is now the very general practice in American locomotive boiler construction. The tender frame is made of 13-in. channels. The tank has a water bottom and holds 7,000 U. S. gallons and carries 10 tons of fine anthracite coal. The weight of the engine and tender in working order is 352,000 lbs. Some of the principal dimensions of the Delaware, Lackawanna & Western ten-wheelers are as follows:

Driving Journals—Main, 10 x 13 ins.; others, 9½ x 13 ins.

Firebox—Thickness of crown, [illegible] in.; tube, [illegible] in.; sides, [illegible] in.; back, [illegible] in. Water space, front, 5 ins.; sides, 5 ins.; back, 5 ins.

Air Pump—1, 9½ ins. L. H.; [illegible] reservoir, [illegible] x 34 ins.

Valves—Type, piston, 14 ins.; travel, 6½ ins.; steam lap, 1[illegible] ins.; ex. lap, [illegible] in.

Setting—[illegible] in. lead.

Wheels—Driv., diam. outside tire, [illegible]; material, cast steel; engine truck, diam., 33 ins.

The following table gives a comparison between this design and some of the more recent examples of heavy ten-wheel engines built by the American Locomotive Company for four important lines.

SIMPLE TEN-WHEEL ENGINE FOR THE DELAWARE, LACKAWANNA & WESTERN.

T. S. Lloyd, Supt. of Motive Power and Equipment. American Locomotive Company, Builders.

Type	4-6-0	4-6-0	4-6-0	4-6-0
Road	N. Y. C. & H. R.	Lehigh Valley.	Oregon R. R. & Navigation Co.	[illegible]
Total weight in working order	208,000	203,000	[illegible]	[illegible]
Weight on Drivers	158,000	[illegible]	[illegible]	[illegible]
Cylinders, diam. and stroke	22 x 26 ins.	21 x 28 ins.	[illegible]	[illegible]
Tractive Power	31,000	[illegible]	34,740	[illegible]
Factor of Adhesion	5.1	4.91	[illegible]	[illegible]
B. D. Factor	646	[illegible]	[illegible]	[illegible]
Heating Surface	[illegible]	[illegible]	2,994	[illegible]
H. S. ÷ Grate Area	[illegible]	37.5	93.2	32.6
H. S. ÷ Vol. of Cyl.	280	283	[illegible]	[illegible]
Grate Area ÷ Vol. Cyls.	4.78	7.6	2.62	8.68

GREAT WESTERN RAILWAY SIGNAL INSTRUCTION

By Felix J. C. Pole

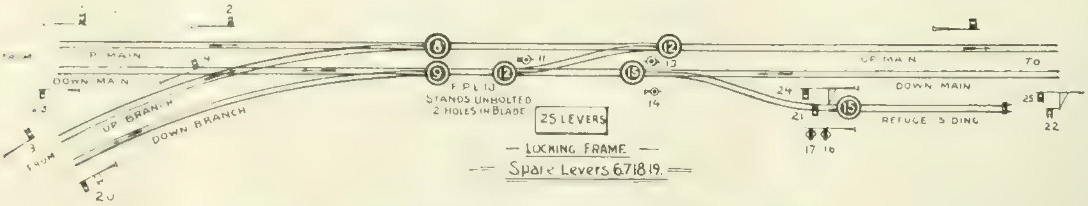
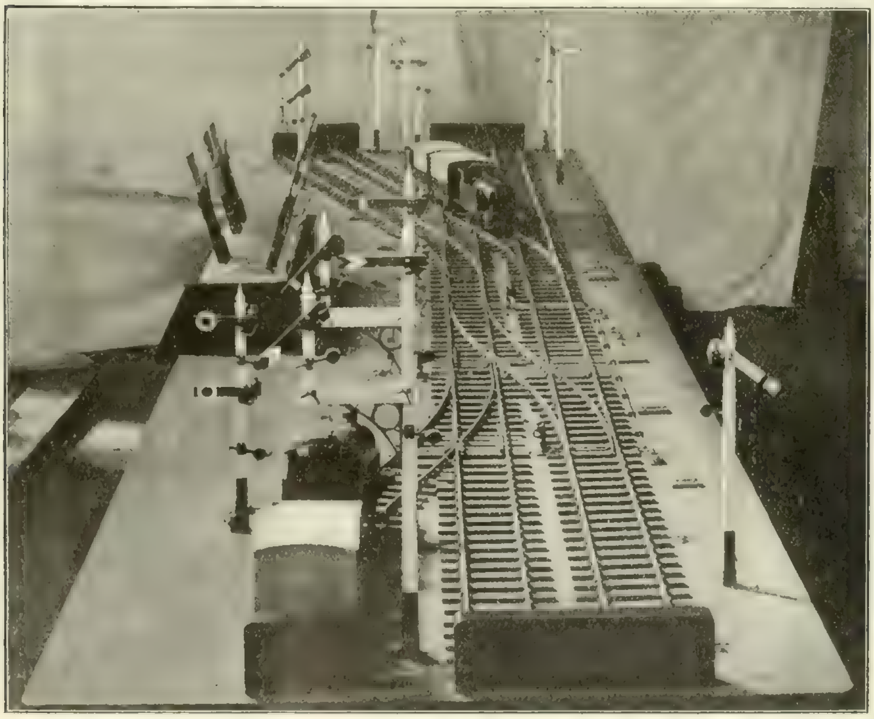


DIAGRAM OF GREAT WESTERN SIGNAL STATION MODEL.

In recent years there has been a sustained movement with the object of securing specialized instruction for railway men in all departments of the science of transportation. This has been notably the case in the United States, and although Englishmen are said to be prone to follow "rule-of-thumb" methods, there is in Great Britain no lack of evidence that the railway officer of the future will be largely chosen from the ranks of those who have been systematically trained in the problems of the profession. Throughout the country, universities and colleges are waking to an appreciation of the fact that transportation subjects cannot be overlooked in providing for the commercial education of the rising generation, and in this direction we may note that the University of London, through the agency of the London School of Economics and Political Science, provides courses of instruction in such subjects as the "History and Geography of Railroads," "Economic Factors in railway alignment, and the operating considerations which influence the location of stations, sidings etc.," "The Law Relating to Railway Companies" and kindred subjects. The Victoria University of Manchester, and other institutions that might be named, are also doing good work, and the chief British railway companies encourage members of their staff to attend the lectures.

At the moment, however, we are chiefly concerned with a development which represents a further, and in some respects more practical, step in railway staff education, taken by the Great Western Railway, the largest railway organization in Great Britain. This is the establishment of classes whereby members of the company's salaried staff may acquire knowledge of railway operation in all its branches, no matter in what particular office or department they may be employed. It was recognized that, in the nature of things, it was impracticable to so frequently move the general body of the staff from one office or department to another as to enable them to secure an all-round training. It was also appreciated that, without such training, even the most capable would be handicapped in acquiring the knowledge necessary to fit them for promotion to superior positions in the service; hence it was determined to form the classes we are about to describe.



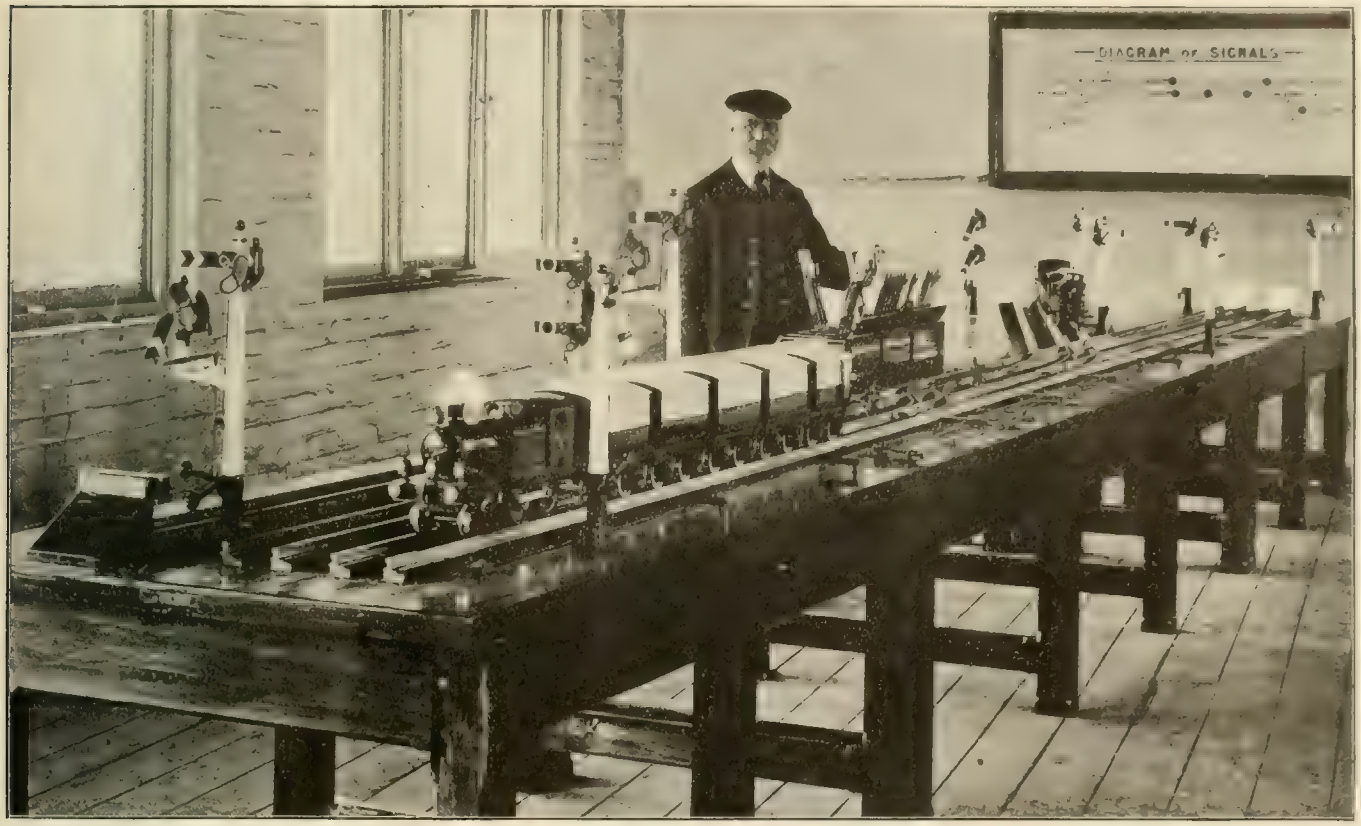
BIRD'S EYE VIEW OF GREAT WESTERN RAILWAY MODEL, SHOWING MAIN LINE, JUNCTION, SPUR TRACK AND CROSS-OVER.

A commencement was made in an unpretentious building situated at Paddington station, London, and the services of a fully qualified official were obtained to act as lecturer and instructor. The control of the classes centered in the General Manager, by whom a programme of subjects was drawn up having a direct bearing on the conduct of transportation. These embrace:

1. The principles of mechanical interlocking of points and signals; working of fixed signals, facing points, trailing points, catch points, level crossing gates, etc.
2. The disc block and telegraph apparatus.
3. Double line block working, with full explanations of the rules.
4. The working of single tracks by wooden train staff, train staff and ticket or electric train staff.
5. A description of the vacuum and Westinghouse brakes, and the regulations in connection with brake working.
6. Slip coaches and the regulations for slipping.
7. The equipment of trains, with special reference to head signals, tail signals, trainmen's duties, etc.
8. Emergency working of double tracks as single tracks, consequent on obstruction or failure of apparatus.
9. Working during fog or snow.
10. Operation of lines when signals or locking gear are out of repair.
11. Precautions to be taken by the Engineering Department when repairing the track, etc.
12. Instructions for working inclined railways and train working on steep gradients.
13. Hand-signalling.

The idea being to reproduce, as far as possible, actual working conditions, a model section of railway was installed, consisting of a double-track junction,

with full equipment of side track, switches and signals such as are usually found at a typical junction station. The signalling is in accordance with the latest British practice, as laid down in the regulations of the Board of Trade, every feature such as interlocking, slots, electric repeaters, ground discs, etc.—being reproduced in miniature. The signal box has a frame containing 25 levers, while working in connection with it are disc block telegraph instruments representing adjacent block posts on the main and branch tracks. Our illustration of the model has been



INSTRUCTION ROOM AND MODEL OF SIGNALS, POINTS, ETC., ON THE GREAT WESTERN RAILWAY OF ENGLAND.

specially furnished us by the General Manager of the Great Western Railway.

The text books are the company's book of Rules and Regulations and the appendix to that book containing in detail the regulations for operating the railway. A course of instruction embraces from fifteen to twenty lectures, and a class is limited to some twenty-five students. Following each lecture a discussion takes place, and the students are required to perform various operations with the aid of the model. Lectures are given weekly during the autumn and winter months, and at the close of a course students may undergo an examination, on the result of which certificates are awarded by the company, the possession of which is specially noted in the recipient's official history and secure for him special consideration in regard to future promotion.

We understand that the experiment has been so successful that classes have been established in various centers throughout the Great Western system. In each case special care is taken to ensure that the lecturer is a fully competent official, while the course of instruction is regularized by the circulation from headquarters of skeleton lectures, indicating exactly what points are to be specially dealt with.

A further development in the matter of staff instruction has lately been made by the formation of classes in railway station accounts and the office work connected with transportation business. In this case also examinations are held and certificates awarded to successful students.

The underlying motive actuating the company is, we understand, to afford all members of the staff, no matter in what department employed, the means of becoming acquainted with the general principles of railway working and business. As a result, several promising men have been "discovered," whose capabilities were such as to render them of more use to their employers in other departments than those in which they were formerly employed.

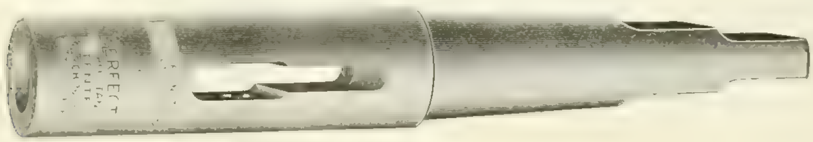
The lectures in no way compete with outside educational agencies or the university courses to which we have already referred; and while it may be contended that lecturing and teaching in the manner described are the essential functions of the collegiate profession, the arrangement undoubtedly has the advantage of [illegible] lecturers who are always up to [illegible] in regard to the rules and regulations of their own railway, in which respect the scheme has much to commend it.

The American Locomotive Company have recently received an extensive order from the Chicago & North Western Railway which consists of 25 ten-wheel freight locomotives and 15 six-wheel switching locomotives. The work of building these engines will be proceeded with at once.

An express on the A. X. & B. Railroad was tearing away at a wild and awe-inspiring rate of six-miles an hour when all of a sudden it stopped altogether. Most of the passengers did not notice the difference; but one of them happened to be somewhat anxious to reach his destination before old age claimed him for its own. He put his head through the window to find that the cause of the stop was a cow on the track. After an hour or so, and then—another stop. "What's wrong now?" asked the impatient passenger of the conductor. "A cow on the track." "But I thought you drove it off." "So we did," said the conductor, "but we caught up with it again."—*Ladies' Home Journal.*

Double Tangs and High Speed Reamers.

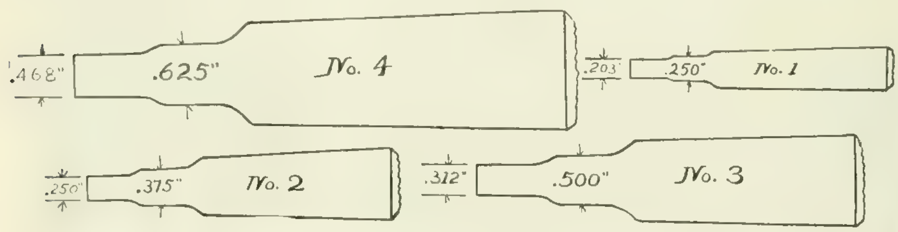
Two new tools making for greater shop economy, have just been placed on the market by the Cleveland Twist Drill Co., Cleveland, O. One is a simple socket for doing away with taper shank tang troubles; the other is a reamer



THE DOUBLE TANG SOCKET

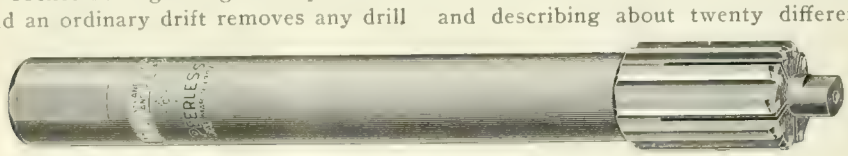
having high speed blades solidly joined to a body of special soft steel.

The simplicity of the "Perfect Double-Tang" socket can readily be seen from the illustrations. It is made entirely of one piece and is practically "fool-proof." Instead of having one slot, like the ordinary socket, it has two, one above the other. The upper slot receives the first, or regular tang of the drill or reamer, when it has not broken off, and the lower slot receives a second



DIMENSIONS OF DOUBLE TANGS, INDICATING RELATIVE STRENGTH.

tang. This second tang is from 25 to 60 per cent. thicker that the regular tang, according to the size of the shank. It can be ground on any shank in a very few minutes and gives to any tool with a broken tang a stronger drive than it had when new. The adaptability of this socket is its other prominent characteristic. This is provided for in two ways: The sockets fit any spindle or socket having a regular taper hole; and an ordinary drift removes any drill



THE PEERLESS REAMER.

whether or not the original tang has been twisted off. If the original tang is gone a small piece of bar steel may be inserted with the taper drift to compensate for the increased distance between the end of the lower tang and the upper edge of the double drift-slot. Any delay or difficulty in changing drills or sockets is thus done away with. These sockets are of the same list price as regular taper shank sockets, and the company's drills and reamers can be had with double tangs to fit them, at the same price as regular tools.

It is claimed by the manufacturers of "Peerless" high speed reamers, that their peculiar construction gives them all the hardness and the good qualities of solid high speed steel tools and at the same time makes them less brittle than any reamer of solid hardened steel. The blades made of high speed steel alone are hardened. They are fitted into and solidly joined to a special, soft steel body, by a process called "Brazo-Hardening," developed and patented by the makers. This process is said to unite the high speed steel of the blades with the soft steel of the body into one solid, inseparable whole. The economies secured by this construction allow of Peerless reamers being marketed at a price very much below that of ordinary high speed reamers. Not the least interesting of the Peerless tools are high speed expansion reamers. They will stand more expansion than carbon steel reamers of similar design and are the only expansion reamers that have the full number of cutting edges of a solid tool. The Cleveland Twist Drill Co. have a new catalogue illustrating and describing about twenty different styles of these tools, which will be sent free to any one interested who writes direct to the company.

Electric Trucks.

A pamphlet just issued by the American Locomotive Company, besides being a catalogue of the different designs and types of electric motor, locomotive and trailer trucks for all classes of service manufactured by the company, contains a good deal of useful data on electric railway equipment which makes

it practically a book of reference for general managers, master mechanics and engineers, and others. The pamphlet contains 114 pages, the first 57 of which are devoted to illustrations and descriptions of the different standard and special types of electric trucks built by the company. The descriptive matter gives briefly the characteristic features of each different type and in the majority of instances each truck is illustrated by reproductions from photographs showing the side and perspective views and also by an assembled drawing giving the principal dimensions, weights and other important data. Then follow illustrations of a few cars equipped with the company's trucks, the principal data of the car illustrated being given under each view. The remainder of the pamphlet is devoted to illustrations and data, conveniently arranged, on electric railway equipment. In this chapter are included the standards adopted by the American Street and Interurban Railway Engineering Association, illustrations together with tables of weights of different makes of electric truck journal boxes, illustrations and table of capacities of ball-bearing, center and side-bearings for electric trucks, illustrations showing different styles of tire fastenings, sections and tables of weights of cast iron, steel-tired, rolled-steel and solid-forged truck wheels, principal dimensions of street railway motors manufactured by the General Electric Company and by the Westinghouse Electric & Manufacturing Company; data on air-brake equipment manufactured by General Electric Company, Westinghouse Traction Brake Company and National Brake & Electric Company, a table of data relative to standard car equipment of electric railways in the United States and Canada, a table of location of third rails, a list of names of the parts of an interurban combination passenger and baggage car manufactured by the Jewett Car Company, table of dimensions and weights of car bodies manufactured by the Cincinnati Car Company, a list of names of all the parts of the American Locomotive Company's standard Type A high-speed truck and material specifications.

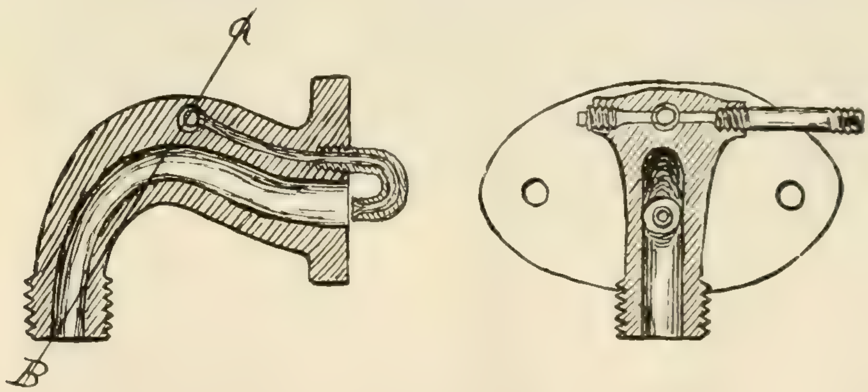
THE REAMER WITH THE DOUBLE TANG

New Locomotive Track Sander.

We illustrate herewith a new locomotive track sanding device, now being placed in the market by the White Locomotive Track Sander Company, of Greensboro, N. C.

As can readily be seen this device is simplicity itself. Two pieces; the body and the air nozzle. Nothing to stop up or get out of order.

The illustration shows a sander of the flanged type to be fastened to the outside of the sand box in place of the hand sander, which can be dispensed with, as this one, after a year's test, under all conditions, has proved itself more reliable than the hand device. It will handle any kind of sand, wet or dry, and operates equally as well with steam or water from the boiler, as with compressed air.



SECTIONAL VIEWS OF THE WHITE TRACK SANDER.

The company also furnish their sander with a threaded end at the sand box connection if desired, as well as sanders with single or double discharge. The company will be happy to give any further information on application made direct to them.

The Grand Trunk Railway Company recently received a cablegram from England announcing that they had been awarded the "Grand Prix" for the general excellence of their exhibit at the Franco-British Exhibition in London.

The Fireman's Duty.

Last month we gave the first portion of the paper read at the recent convention of the Traveling Engineers' Association on the important, and one may almost say personal question, "in what manner can the road foreman of engines best assist in increasing the net earnings." The paper was read by Mr. J. McManamy, chairman of the committee, of which the other members were Messrs. E. Hartenstein, C. E. Rush, A. G. Turlay and L. D. Gillett. We are now able to print the concluding part of the paper in which some observations are made concerning the fireman's duty.

"The fireman also has a very important duty to perform in connection with economy in the use of fuel. The qualifications for a good fireman are: First, intelligence; second, physical strength and endurance. In the majority of cases no large amount of strength is necessary for proper firing, in itself, and we usually find the best firemen are not those who can raise the heaviest weight, but rather the man with moderate strength and great endurance. They are the men who fire properly and keep constantly at it. The strong man who depends on strength alone will handle more coal and work harder, will be exhausted and require longer periods of rest, all because he has performed much useless labor and incidently thrown away a large amount of valuable coal. Comparisons between the fair-sized, wiry fireman who uses his head and the strong fellow who heaves coal can be seen at almost every division point in this country, and almost invariably results in favor of the former, provided he has been given proper instruction. As far as placing the coal on the fire is concerned, it consists chiefly in convincing the men, both by sound reasoning and actual example, that it will pay, and pay well, to scatter well-broken coal in small amounts on various parts of the fire at frequent intervals of time to avoid reducing the temperature of the firebox below the igniting temperature of the gases, which would result in a waste of fuel on account of the gases passing away unburned in the form of smoke. This, of course, with the modern locomotive, means almost constant firing, but in most cases it is leisure work, and it is the way the locomotive must be fired to get the best results.

"Right here let me digress from the topic to introduce a thought, which can be found in the 'Ruling Passion,' by Henry Van Dyke. In giving a description of two types of human nature, Van Dyke states that 'he had natural force enough and to spare; whatever he did was done by sheer power of back and arm. He could sent a canoe up against the heaviest water, provided he did not get mad and break his paddle, which he often did. He had more muscle than he knew how to use.' In the other character, Van Dyke states: 'This one did not have as much muscle as the other, but he knew better how to use it. He never broke his paddle unless it happened to be a bad one, and then he usually had another one in the canoe. What he did was done more than half with his head.'

"It devolves upon the road foreman of engines to get hold of the fellow with a surplus of muscle and a lack of head capacity, and lead him to a realization of the simple fact that it is what a man can do with his capacity to think that produces results rather than his muscular prowess, and through this capacity of discernment and the ability to lead others into the right way of thinking, which will of necessity bring about the right way of acting, the road foreman of engines can, in my opinion, do more to increase the net earnings of the railroad than in any other way.

"Another very important item to my mind is the intelligent reporting of necessary work to be done on the locomo-

ENGINEER, FIREMAN AND CONDUCTOR, WITH PRIVATE CAR SPECIAL ON THE EAST BROAD TOP RAILROAD.

tive, and I believe this item is the cause of one of the great losses to the mechanical department of a railroad. Every road foreman of engines has noticed in looking over the work book a whole page of work which either was not needed or reported in such an unintelligent manner that it would be necessary for the round-house force to tear the engine all to pieces in order to find out what work was necessary to be done, reporting as follows: 'Examine cylinder packing,' 'examine air-pump,' 'examine injector,' 'engine does not steam.' Such items are frequently found on the work book, not specifying any particular thing nor giving the round-house force any information as to where to find the trouble, thus causing a large expense for high-priced labor in finding the trouble, which could have been remedied at a small per cent. of the cost if the report had been made out intelligently, so that the man doing the work could have gone directly to the job and done it. By properly educating the engineer to report his work intelligently so that no time will be lost in looking up the defects, the road foreman of engines will be able to get as good results from the engineer's report as from personal inspection.

THE ENGINEER'S RESPONSIBILITY.

"Another item which I believe should not be lost sight of is carelessness on the part of the engineers in handling the engines in their charge. Some of them do not seem to consider it necessary to pay particular attention to keeping the sand in operation to prevent unnecessary slipping of the engine in starting a train or on a hill, nor do they always consider the amount of fuel that is unnecessarily burned by slipping the engine. It is a frequent occurrence to find loose nuts or or leaky pipes that could have been tightened by the engineer on the road if he would improve the opportunity to do a little work on the engine instead of ignoring any little jobs that could have been done by him. In fact, too many of the younger engineers are entirely helpless when it comes to doing what is considered a locomotive engineer's duties, such as keying up rods, setting up wedges and reporting work intelligently on the engine. In many instances, engine failures are caused on account of the engineer or fireman not doing the right thing at the right time, and the expense of these engine failures is enormous to the railroads when it comes to figuring up for the engine and train crew and the delay to traffic.

AUTHORITY OF THE ROAD FOREMAN.

"The opportunity for the road foreman of engines to increase the net earnings is much better if he has direct charge of the men under him, and they should know that if they do not follow out his instructions they would be subject to discipline or dismissal. If the road foreman of engines must report irregularities he finds on the road to the master mechanic, it does not give him an opportunity to handle matters to the best interests of the railroad, for many times when he finds enginemen neglecting their duty, if he is not in a position to correct it right then and there, the value of his services is very much impaired by having to make a report of the conditions to the master mechanic and then have an investigation held over a matter that should have been corrected at the time of the occurrence.

"The road foreman of engines should study human nature in order to know his men. He should get the men to feel that he is interested in them and get them interested in him, and he will get them interested in their work. We are all human. I have never yet met the person who did not appreciate a word of commendation. I have never yet seen a fly that did not prefer a small quantity of molasses rather than a large quantity of vinegar. By this, I do not mean that wanton disregard of regulations should be winked at or condoned, but when it is necessary to reprimand, if you will control your passions and not speak in an angry tone to the one you are called upon to discipline, but keep your self-control, recognizing that the one you are called upon to punish is like yourself a

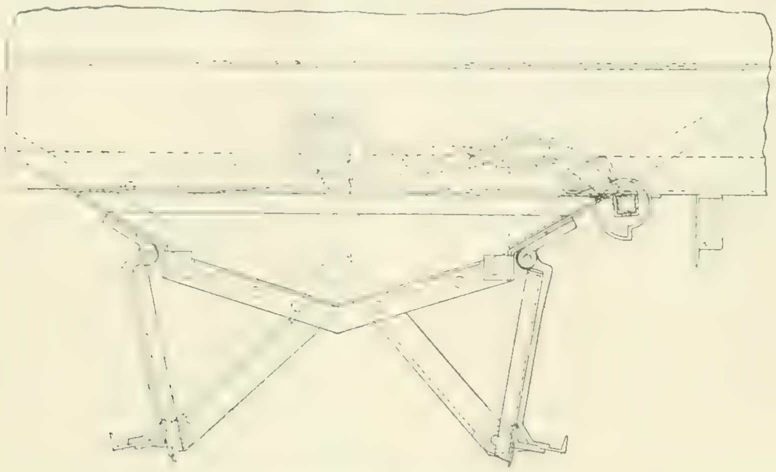
ERIE PASSENGER FERRY AT NEW YORK.

human being, and will treat him in the way you want your superior or executive officer to treat you when you make a mistake, you will get better results out of the discipline and will find that you are working directly in the line of increasing the net earnings of the railroad. Harmony has never been attained through fighting or by war in any of its modifications. Harmony is had only through gentleness and dealing justly with one another, and along the lines of doing unto others as we would be done by, and in doing this we will avoid the unjust criticism of the other person, regardless of whether that person is employed in the same branch of the railroad service as we are or not, and without regard to what his vocation may be."

Men often make up in wrath what they lack in reason.—[illegible]

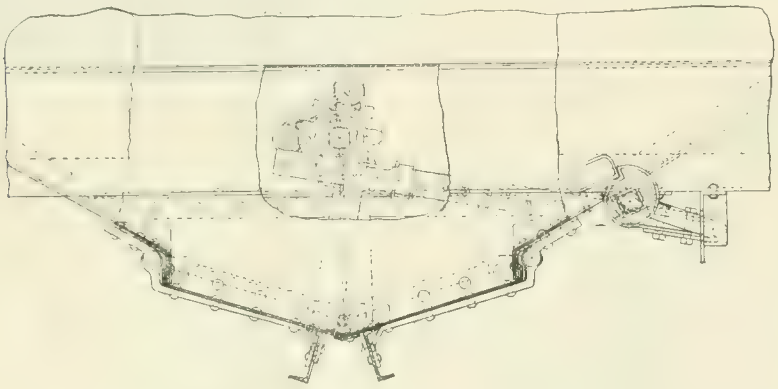
The Trenton Car Hopper Door.

The car hopper door made by the Trenton Malleable Iron Company, of Trenton, N. J., under the Johnson patents have been in successful operation for a number of years and have been used by a number of our leading railroads. The present make of these doors in an improvement upon the original design while retaining all the good features which have been proved by long and constant service. The door opening and closing mechanism is where the secret of their success lies. The device is simple, strong, and positive in its action, there being no chain to slack, and no lost motion to take up, or break, and being composed of only a few parts does not get out of order.



TRENTON HOPPER DOOR OPEN.

Referring to our illustrations of the Trenton door, type Z, it will be seen that there is a shaft, outside of, and entirely clear of the doors which passes under the sills. This shaft is operated by a wrench, the portion between the car sills has a crank by which movement is transmitted to a rack which engages with a pinion mounted upon a second shaft over the center of the door. On this second shaft is a fixed arm from which a link extends to a pin connection which holds the ends of two other links which are attached to the door.



STEEL CAR HOPPER DOOR CLOSED.

When the door is closed these links fold up, as it were, about the shaft carrying the pinion, and the first shaft automatically locks, as the center of the crank to which the rack is pivoted turns far enough to carry the crank beyond the center, where it comes to the rest iron that holds it from going any further. It remains locked until the crank is forced back past the center, thus the doors are held tightly shut and without any possibility of sag or gape, or any danger of loss of material which the car may be carrying. The locking pawl is used only as a precaution, and to make assurance doubly sure.

When the doors are being opened a wrench is used to turn the first shaft, and when the crank is turned back past the center, the weight of the doors and the load in the car, tends to open the doors for discharge. The rapid opening of the doors due to the weight of the load, would throw the wrench and seriously jar the operator, but for an ingenious but simple provision. When the shaft turns suddenly and with force, its end turns in the jaws of the wrench, as one corner of the square end has been cut away, the wrench in the hand of the operator is not jerked in any way, and the danger of personal injury to the man is thus entirely avoided.

The whole door-opening mechanism is substantially designed and is proportioned so that comparatively little force is required to operate it. The locking

feature is automatic, all the attachments and fastenings though above the doors are protected by a sloping covering between sills and are thus out of the path of the load and out of the way of ice and snow in the winter. They are thus easy of inspection and can be got at readily when the doors are open. The large leverage provided in this design, is such, that in case of frozen load the doors still open freely and quickly. These doors can be applied to any ordinary style of hopper without any change in construction of the car. Any communication addressed to the Trenton Malleable Iron Co., 50 Church street, New York, on the subject of hopper car doors, will meet with a prompt response, and they will be pleased to send their catalogue showing the different types of doors for different kinds of cars.

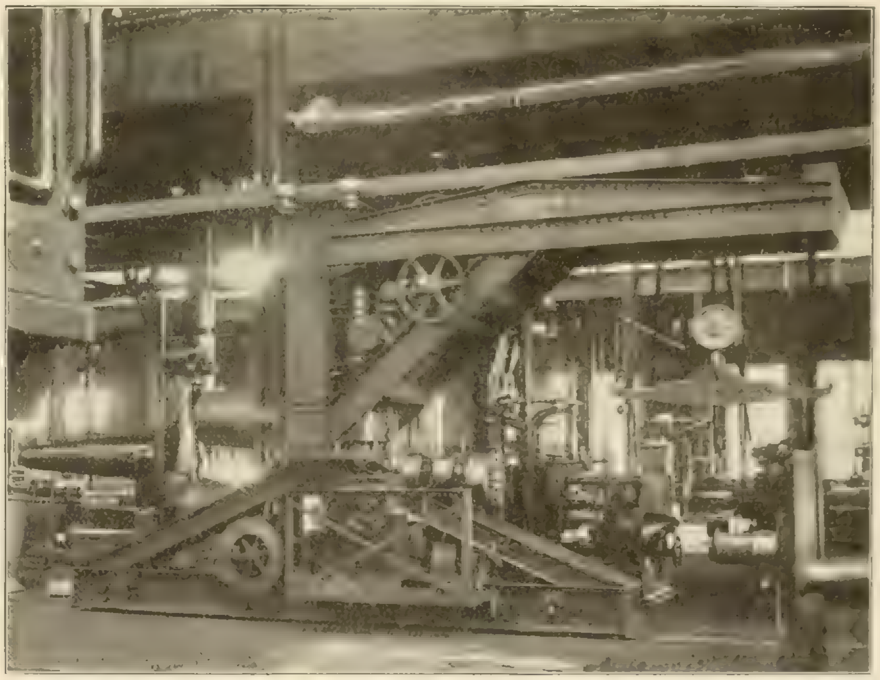
Walking Jib Crane.

The Illinois Central Railroad has lately secured a very substantial and useful crane, which they have set up in their Burnside shops, the mechanical headquarters of the company at Chicago. The crane is shown in our illustration and it is a good specimen of the excellent work done by the Whiting Foundry Equipment Company of Chicago. The work of the crane is to pick up and distribute wheels and axles to wheel lathes, and to carry wheels for storage, or to other places along its "line of march." We say line of march because the crane moves along a single track, and is called an electric walking crane, for it does the work of a giant walking upon a beaten path.

This crane is of seven tons capacity; it has four motors, and 12 ft. effective radius. It is supported on one track rail, and the top of the mast is supported by an I beam track. It thus requires minimum floor space. All the wearing parts are easily accessible for oiling and repairs. It was specially designed for the Illinois Central, and is admirably adapted for the work it now has to perform. One feature is its low head room. The four motors are distributed as follows in the working of this crane: One for traveling the crane, one for the trolley, one for the rotating jib and one for hoisting.

An important feature not to be neglected is the fact that the load is always in absolute control, being automatically sustained at all times. The hoisting gear is provided with an improved double automatic safety brake, so arranged that the load may be raised or lowered by power and all the time be automatically sustained. This brake attachment consists of two independent brakes, one electrical and one mechanical. The electric brake is operated by an electric solenoid in circuit with the hoisting motor, and so arranged as to come automatically into action when the electrical current is cut off the hoisting motor circuit. The Whiting Company claim a maximum of efficiency for this crane in the service it is designed to perform, together with a minimum of cost as to installation and repairs. It is instanced as one of the many crane installations of this company which greatly facilitates production in modern locomotive repair shops, and other plants.

The crane travels on what may be called a permanent mono-rail track,

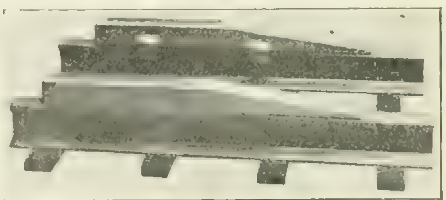


ELECTRIC WALKING CRANE IN THE BURNSIDE SHOPS.

running the entire length of the shop at right angles to the erecting pits. The track is laid as close to the columns separating the erecting shop floor from the machine shop floor as clearance permits. In this way the shop crane serves the erecting pits on one side of the track and the wheel lathes on the other. The hoist motor is 15 h.p. and hoists 16 ft. per minute. The trolley rack motor is 2 h.p. The trolley racks on the jib at the rate of 90 ft. per minute. The jib rotating motor is 2 h. p. and swings the jib at the rate of two revolutions per minute. The crane travel motor is 10 h.p. and travels the crane at a speed of 180 ft. per minute. The jib is fixed in a horizontal position and is not raised or lowered. The maximum lift of the hook from rail is 10 ft. Altogether the walking electric crane is a good piece of engineering construction and although it is very sustantially built, it is able to perform the work exepected of it efficiently and quickly.

A Wheel Raiser.

The locomotives in use to-day are heavy machines and it is a matter of common knowledge that the ordinary screwjacks carried on the engine are usually inadequate to the work of raising these engines when out on the road



MICHAEL'S WHEEL RAISER.

without a good deal of trouble and loss of time. The jacks are not used often enough to keep them in a constant state of repair and when carried in the tool boxes of the engines are apt to corrode and become practically of no use for a hurried call when a spring hanger or other member of the spring system becomes disabled on the road.

There is a very simple remedy for this kind of trouble which has been devised by Mr. J. B. Michael, master mechanic on the Southern Railway at Salina, Ala. It is, as he calls it, a raising block. The raising block consists of a flat piece of iron or steel made to fit the top of the rail, with two lugs on the inside to prevent it from falling off the rail, when laid in place. One end of the "raising block" is sloped down so as to permit the driving wheel to easily roll up on it, and the flat top part of the block is roughened so as to prevent any possibility of slip when the wheel is up on the block.

The method here outlined for quickly taking the weight and blocking the driving box in case of failure of some part of the spring system, has the advantage of dispensing with manual labor, and the wheel can always be raised. When jacks are employed blocking has to be used also and it is not always available, and placing it takes time. Michael's rasing block has all the elements of a time and labor saver about it.

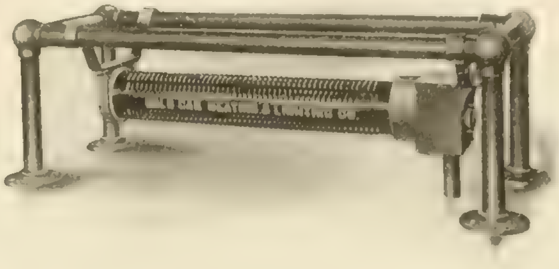
At a meeting of stockholders of the Ward Equipment Company, held at the office of the company, 141 Broadway, New York, on October 12th, last, the directors and officers for the ensuing year were elected. Mr. John E. Ward was elected president; Mr. Alfred W. Kiddle vice-president, and Mr. T. W. Bates secretary and treasurer. Mr. A. E. Robbins was appointed Eastern representative and Mr. Henry G. Horn Western representative. The president reported that the company had been very much more successful in every way than he had predicted in his last report to the stockholders. The business of the company in both the car heating and ventilating departments is growing more rapidly than was expected, and the president was authorized to either purchase or erect a suitable building in the city of New York where both the offices and the warerooms of the company could be located; this building to be of suitable size to take care of the growing business of the company.

The hard times which have been with us long enough, and which have meant the reduction of output in many manufacturing establishments, have been utilized by the wise in overhauling their machinery, revising their methods and getting up new designs, and doing such other work as is usually neglected in a period of prosperity. The National-Acme Manufacturing Company of Cleveland, Ohio, makers of automatic screw machines, etc., have been busy during the dull times, and one of their activities has been in the direction of developing their single drive on the "Acme automatic" multiple spindle screw machine. One belt or one motor takes the place of the multiple belts. In its effect on the manufacture of duplicate milled parts, this improvement ranks second only to the introduction of multiple spindles, where the "Acme" people were the pioneers. This new arrangement makes this tool a safer, simpler, more powerful, more productive and more convenient machine. Write to the company for further information.

Energy and determination have done wonders many a time.—*Bleak House.*

Substitution and Repairs.

What is generally called Maintenance, in railroad practice is really composed of repair and substitution. Repair is the making good of broken or worn parts or even a readjustment of mechanism. This is done in the shop by skilled workmen without hurry or fuss. Substitution consists of removing a defective piece of equipment and applying a similar piece which has been repaired and tested in the shop. The ability to do this rapidly and easily is partly the work of trained men, but it is more the result of a carefully worked out design. Repair work and substitution are distinct operations and together they make up what we usually call maintenance.



ELECTRIC HEATER IN PLACE.

As good example of this we may mention that new electric car heater and junction box brought out by the Gold Car Heating & Lighting Company of New York. The heater is of course a resistance coil which in opposing the current of electricity forced through it, radiates heat, several of them being able to warm a street car or railway coach on an electrically operated road. The resistance coil is enclosed in a perforated steel case which is hung under the car seat. The point of excellence in the design which makes it easy of substitution is the fact that if for any reason the coil has to be removed, the wiring of the car is in no way disturbed as what is called the junction box, which is really the terminal for the permanent wires, hangs under the seat and is not touched when the resistance coil is taken out. In fact substitution is here almost as easily effected as the removal of a glow lamp from its socket in a dwelling house, and hardly any more skill is required. Time saving, which is one of the requisites of substitution, is secured in this way.

Our illustrations make clear the style of heater, the pipe frame shown is, however, only for exhibition purposes as "in real life," the hangers are attached to the underside of the seat. The first illustration shows the heater in place, with its compact protecting casing and the fixed junction box at one end and the removable hanger on the other. The second illustration shows the heater disconnected, with cover and casing on the floor, the junction box case beside it and the wire terminals hanging in place from the under side of the seat. The ends of the resistance coil extend out beyond the casing in the form of two plugs and these plugs fit into two sockets in the junction box. The act of putting the resistance coil in place makes the connection and the tightening up of the movable hanger makes everything snug.

In this way the designer has succeeded in making a device easy of removal. It can only be put together in one way, and it has few parts. These are features of design which generally mark the most successful devices and they have the effect of saving time by reducing the work of substitution to its lowest terms. Repair work proper, when necessary, is done in the shop while the car is kept in service. Substitution is like a smoothly run play on the stage, repair work is like the preparation which goes on behind the scenes, and in either case a good performance and economical maintenance is the result.

Some rather interesting statistics concerning the Pintsch system of lighting trains all over the world, has lately come to our office. It appears that Germany leads with over 52,000 cars, lighted with Pintsch gas; Great Britain is next, with over 20,000, and France follows with more than 11,000 cars. The railways of the United States and Canada have a total equipment of above 32,000 cars using this system, which is controlled by the Safety Car Heating and Lighting Company of New York. This shows that the use of the Pintsch light on this continent about equals that of Great Britain and France combined, while it is considerably below Germany. Austrailia has over 13,000 cars so equipped, and other countries in proportion. Servia and Bulgaria have together 373 Pintsch lighted cars, and American travelers in [illegible]

READY FOR SUBSTITUTION

the Pyramids and the Nile can read by the Pintsch light as if they were at home.

There are all over the world 156,172 Pintsch lighted cars and the increase in equipment during the last four and a half years has been 35,301, which means an average increase per annum of 7,845 cars. There are all over the world 8,579 locomotives using the Pintsch light.

Railway Work in Siberia.

We have received a communication from the firm of B. K. Peters & Co., Omsk, Westsiberien, Russia. This firm has an office in London, and a resident member in Russia, at the address given above. We print the notice sent, in the interest of our many advertisers who may be looking for a market for their supplies in the land of the Czar. The news item is as follows:

"Railway development in Siberia is at last taking a move forward, for in addition to the laying of a second track to the trunk line of the Great Siberian Railway, the Russian authorities have decided that a number of branch feeding lines shall also be commenced. These lines many of which are upwards of 200 miles in length, will connect up two or more important trading centers with the main line in each case; to avoid delay it is proposed to grant concessions for the construction and working of these branch lines to capitalists willing and able to carry the work to a successful conclusion and those interested are invited to communicate with Messrs B K. Peters & Company of Omsk, Western Siberia, who are open to represent such interests at an Official Conference which is to take place in December next and which will be under the Presidency of one of the Siberian Governors General."

Universal Directory of Officials.

This useful volume for 1908 was sent to us some time ago by A. Fenton Walker, 143 Liberty street, New York, United States agent for the book. The Universal Directory takes in the railways of the whole world and gives particulars of mileage, guage of track, locomotives, cars, steamboats and equipment generally, besides giving the names and addresses of the leading officials. From a careful examination of the book we are able to testify to its accuracy and breadth of information. The numerous business houses and individuals who require to correspond with railway officials all over the globe will find this directory invaluable. We heartily commend the book owing to its reliable character.

Three prizes, aggregating $500 in money, have been offered by the J. G. Brill Company of Philadelphia, for essays (or as they call them in college, theses) on the subject of design of an electric railway car for city service. Those eligible for the prizes are the senior students of the technical schools of the United States who will graduate in 1909. Each thesis will be judged on its technical merit and on the manner in which the subject is presented. A jury of three will award the prizes One will be an electric railway official, another, a member of the editorial staff of one of the technical journals in the electric railway field, and another an expert in car constructions. The names of the competitors will not be known to the members of the jury until after the award has been made.

Railroad Nightingale.

The Chicago & Alton have a fast train leaving Kansas City at 10 P. M. every night for Chicago and a corresponding train out of Chicago. These are trains Nos. 11 and 12 and the name "Nightingale" has been given to the east and west-bound train. The name was the result of a vote taken by the Alton among its patrons, and of 10,000 votes cast for a name for the Alton's fast train, 6,000 favored Nightingale, and this has been adopted. The person who suggested the name is to receive a prize of $50. The train is scheduled as the Nightingale in the official railway guide.

Locomotives and Forest Fires.

The report of the forest fish and game commission of New York State, estimates that 90 per cent. of the forest fires in the Adirondacks were started by sparks from locomotives, and the Public Service Commission for the second district called upon eighteen railroad companies to show what devices were used by them and what precautions were taken to prevent forest fires being started along their right of way. A law recently passed at Albany requires the Public Service Commission of New York State to enquire into the matter upon request of the forest commission, to require any railroad company running through forest lands to adopt such devices and precautions against setting fire to the forests as the public interest requires.

"The History of the Development of the Locomotive," by Angus Sinclair, continues to grow in popularity. A railroad general manager recently wrote congratulating the author on his work and added that it read like a novel.

The way out of our narrowness may not be so easy as the way in. The weasel that creeps into the corn-bin has to starve himself before he can leave by the same passage.—*Bartol.*

CONTENTS.

Railway and Locomotive Engineering

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A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXI. 114 Liberty Street, New York, December, 1908 No. 12

The International Limited.

The Grand Trunk System owns and operates what was the first railway in the Dominion of Canada, and the second on this continent. In 1853 the Grand Trunk Railway of Canada was projected. It was intended to be "a main trunk line of railway throughout the province." This road absorbed several of the existing smaller lines of railway, the principal one of which was the St. Lawrence and Atlantic which was leased in perpetuity. The Grand Trunk was originally 5 ft. 6 ins. gauge, but in 1873 it was changed to the standard 4 ft. 8½ ins. The change of gauge was accomplished very rapidly when the work was started, as plans and arrangements had been carefully made in advance. On some portions of the road one rail only was shifted over against marker spikes, driven so as to approximately give the new position of the rail, then the track was accurately gauged and the rail spiked in place. Many interesting details concerning the early history of this pioneer railway of Canada are to be found in Dr. Sinclair's well known work on the "Development of the Locomotive Engine" in the chapter devoted to Railway Development in Canada, written by Mr. George S. Hodgins.

The Grand Trunk, as we have said, was a road of small beginnings; in the early days it did business at first with less than twenty miles of line connecting Montreal with St. Johns, Que. As the Dominion developed, the road was extended to Toronto. The line from Niagara Falls to Sarnia was acquired and other lines were absorbed, until to-day the whole is called the Grand Trunk System. The present Eastern terminus is at Portland, Me., the western terminus, in Chicago. Thus it is an international line. Just now a new line is being built from the Atlantic to the Pacific, a thousand miles of which have been completed. This is called the Grand Trunk Pacific. It was conceived by the present management of the Grand Trunk Railway Sys-

THE IMPERIAL LIMITED ON THE GRAND TRUNK RAILWAY OF CANADA.

tem, and is being built under the direction of Mr. Charles M. Hayes, vice-president and general manager, who has brought the Grand Trunk Railway of Canada from being an ordinary single track line to its present high state of efficiency with many miles of double track. The Grand Trunk Pacific will cross the continent with a maximum grade of four-tenths of one per cent. from the Atlantic to the Pacific.

The International Limited is a fine train. It consists of a combination baggage and smoker, day coaches, café parlor and library car and Pullman sleepers. The run from the Metropolis of Canada to the Queen City is made in 7½ hours, the distance being 333 miles, which gives an average schedule time, including stops, of 44.4 miles an hour. This run is made over a magnificent double track road and between stations the speed is often 60 miles an hour.

Every morning at 9 o'clock, on every day in the year, the International Limited leaves Bonaventure Station in Montreal, for Detroit and Chicago. When she swings out over the switches, through the crowded freight yards, by shops and factories, past the roundhouse with its 50 stalls where they stable these steeds

G. T. R. STATION AT BATTLE CREEK, MICH.

of steel and steam, she is already bowling along at a mile a minute. Here and there on either side of the roadway are country clubs and golf links, and between them clover fields, and then on through what seems to be a new made city of tiled-roof houses. These are the buildings of the Macdonald College where one Canadian philanthropist has spent five millions. This is St. Anne de Bellevue. Here the train crosses two arms of the Ottawa river and a little later is rushing along the shores of the great St. Lawrence, whose green waters glint through the trees now and then until the train has passed Brockville, Kingston, and Belleville. Here the road begins to skirt the shores of Lake Ontario, in the province of that name. This part of the line lies through a rolling region, a pleasing and prosperous farming district. Having pushed up a steep grade to the summit of Scarboro' Heights the train rolls down into Toronto, the capital of Ontario, at 4:30 P. M., having covered 333 miles in 7 hours and 30 minutes, including eleven stops.

Leaving Toronto, the train enters what is often called the "Garden of Canada," the best part of which, however, lies east of Hamilton, which is the next stop; 39 miles further on. Leaving Hamilton the train climbs up the shoulder of the bluff

G. T. R. GENERAL OFFICES, MONTREAL.

hills in the township of Flamboro'. The incline is steep and is known on the road as the Copetown grade, but on the powerful engine forges its way until the train lifts us from the level of Lake Ontario to the level of Lake Erie. Here we get a magnificent view of the famous Dundas Valley, a bit of rural scenery unsurpassed in Canada, if anywhere on the continent. The next stop is at Brantford, a prosperous manufacturing town. At London, an important commercial center surrounded by a rich agricultural district, the train splits, the main equipment, the International Limited proper, going to Detroit, via Windsor, the other part going to Chicago via Sarnia. At Sarnia the steam locomotive is taken off and replaced by a powerful electric motor which sweeps the train under the St. Clair River, through the recently electrified St. Clair Tunnel, which is a blaze of light.

The electrification of the St. Clair Tunnel has attracted the attention of engineers in all parts of the world. The installation of the electric plant cost $500,-

AMONG THE ISLANDS ON THE GEORGIAN BAY. G. T. R.

000, including the power plant, locomotives and other equipment for an overhead wire power supply system. Four heavy electric locomotives have been built for the work. They are among the largest of their kind in the world and can haul trains at an average speed of 10 miles an hour up the heavy tunnel grades. The new system also insures safety in operation, as the St. Clair tunnel, since its completion in 1891, has been the scene of several fatalities by reason of the tunnel becoming filled with smoke and gas if by any means a train became stalled in the tube. Under the electric system the interior of the tunnel has been brilliantly illuminated with arc lights and has been painted white. The absence of coal gas fumes and the good ventilation make the air in the tunnel now so pure that the car windows can be left open during the entire trip through the tube, which dips down below the river bed and rises up to shore level on the other side.

Port Huron is at the Western end of this International tunnel and now the splendid train travels through Michigan, by Battle Creek with its famous sanitarium and its breakfast food factories; by Durand with its many railways; by Lansing, the capital, and on through Indiana to Chicago, which is reached at 8 o'clock in the evening.

Great improvements have been made by many American railways; many mill-

G. T. R. STATION AT BRANTFORD, ONT.

ions of dollars have been expended, and among them must be ranked Canada's first great railroad, for it has accomplished more during the last ten years in the way of actual improvement, in speed, in comfort of travel, than ever before, and the famous International Limited is one of the proofs of the progress and energy which characterize the management of that road, and the "men of the Northern Zone." Our illustrations show first the Imperial Limited hauled by a powerful 10-wheel passenger locomotive, built at the Grand Trunk Shops at Point St. Charles, Montreal. The picture was taken on a stretch of splendid double track line and is a good example of the power and the track. Our other views show scenes in the Thousand Islands, a piece of the straight road through the garden of Canada. Another view shows two of the electric locomotives at the entrance of the famous St. Clair Tunnel connecting Sarnia on the Canadian side with Port Huron, Mich. The station at Battle Creek, Mich., and the station at

Brantford, Ont., are fine examples of the substantial and artistic buildings owned by the railway. A view of Montreal from the heights of Mount Royal shows the closely packed city below and the Grand Trunk Bridge crossing the St. Lawrence in the distance. The view of old Quebec is taken from the ramparts of the historic citadel, over which has flown in early days the flag bearing the golden lilies of old France and later the British Union Jack. Quebec this year celebrated the three hundredth anniversary of the days when Samuel de Champlain sailed from Brouage in France and founded Quebec, the first permanent city in North America, on the 16th day of July, 1608.

Capturing Train Robbers.

Some interesting details of the "hold ups" which took place some years ago were given by Mr. C. O. Eanes, chief special agent of the Missouri Pacific, at one of the meetings of the St. Louis Railway Club. When describing the capture of the men concerned in a Southern Express robbery, he said:

"While we were waiting at Siloam Springs, we received word of the robbery of the Southern Express out of Coffeyville. The night before Christmas was when this robbery occurred. I was detailed to take up that work, and I selected seven of the best Deputy U. S. Marshals, and they were good men. We went to the scene of the robbery and made a careful investigation; had all the train crew there, but secured no details whatever,—no information whatever that would show us who the criminals were. We only found out that there were four men on horseback. We then went to Coffeyville, and I stowed the marshals away in a hotel, found the Deputy U. S. Marshal of Coffeyville, who told me of a rancher who lived five miles from Coffeyville, who was a great friend of the outlaw; that is, a great friend to the scouting-man, the man who is scouting and hiding from the law. I rode out to this man's place one evening, and after a long talk with him he agreed to get me some scouters. Of course you may not all know what this means.

"A 'scouter' is a man who has committed some crime, and there is a warrant out for him, and the U. S. Marshals are looking for him. Of course the deputy marshals are paid by the work they do, and therefore they do all the work they can, in so far as arresting the men after the warrants have been issued.

ELECTRIC LOCOMOTIVES IN THE ST. CLAIR TUNNEL, G. T. R.

LONG TANGENT THROUGH THE "GARDEN OF CANADA," G. T. R.

"In two days I was furnished with two men, one Evans, a man who had stolen horses several times, and had been in jail and escaped, so there were several charges against him, and a young half-breed called Cherokee-Bill. He was half Cherokee Indian and half negro.

"With these two men I started out to do my work. I sent Evans into the Verdegris Valley, which is east of the Iron Mountain track, and south of Coffeyville. He was to look for men who were away from home, with their horses, tough men, young or old. I took the half-breed and scoured the entire country south and west of Coffeyville as far as Bartelsville, which was then simply a store and two or three houses. This whole country south of Coffeyville and west is filled up with ranchers, many of whom are on friendly terms with outlaws, so friendly that they will feed and hide and protect them from the Deputy U. S. Marshals.

"My plan was to visit all these houses, with the half-breed boy. I would ride within probably 200 ft. of a house, and hold his horse, it was at night, of course, while he called up the house to get something to eat,

and talk with the farmer, and satisfy himself as to whether there had been any criminals lodging or eating there or passing through there. We were partially unsuccessful until we reached Bartelsville on our way back, after a two weeks' trip.

"You can judge that this proceeding


VIEW OF MONTREAL FROM MOUNT ROYAL.

was rather hazardous on my part, for not only was I in danger from outside foes, but the man with whom I was traveling was an outlaw and he knew that I had the money rolls for the Deputy U. S. Marshals who were staying back in Coffeyville.

"Returning by way of Bartelsville, we found a house where four men had stopped for breakfast on Christmas morning. These men were not all known to the people at this house; two of them, however, they stated had come from Kiowa, Kas., and were known as the Turner brothers. The other men they did not know, but they thought that those boys had held up a train, as they all had black silk handkerchiefs which they had used as masks, and from their talk they thought that they had been train robbers.

"We returned then to the rancher's, and there I met my man Evans from the Verdegris Valley. He informed me that he had been successful, and had found that a young man named Bob Rodgers and a man somewhat older, named George Brown, were away from home; that they had taken their horses and their Winchesters and they did not expect to be back until February. Later on, while talking to the younger brother of Bob Rodgers, Evans found that these men had gone out with the intention of holding up what was then called the 'Valley train.' We thought sure that we were on the right track, and I then sent Evans to Kiowa, to find out where the Turner boys were, and when they were expected home. I again made the trip with the half-breed scouring the country south of Coffeyville, and finally I left the half-breed at Bartelsville at the same house from whence he got his information, and returned to Coffeyville. There I met Evans, and he said that the Turner boys had left their home in Kiowa two days before Christmas with their horses and with their Winchesters; I then felt sure that we had the whole gang located. All we wanted to do was to find out when they came back into the Territory.

"The very next morning the half-breed came from Bartelsville with the information that the whole gang and one more had passed through leading a string of horses; evidently on their way towards the Verdegris Valley, or towards Vinita, which you can understand better.

"I at once sent both Evans and the half-breed to the Verdegris Valley, advising them to go separately, and go to the Rodgers' home to find out if Bob Rodgers with his gang had come there. I took my Deputy U. S. Marshals, who were chafing at the bit for having to stay still so long, and we went to Vinita by train, arriving there in a short time. In two or three days I was able to locate my scouts at the outskirts of town, and I learned that the entire gang was stopping at Rodgers' house; that two of them, Rodgers and Brown, had gone to Coffeyville for ammunition, and they were expected back and as soon as they came back, the whole gang were going up into southwestern Missouri, to rob two or three banks. They had it all planned out, about what they were going to do.

"Knowing that we would have to wait until the whole gang got there, if we captured them all, I made arrangements with a rancher who lived near Vinita, about 30 miles from there, to accommodate us in the garret of his house until these people came back, and were all together, at home. I made up my mind that we would take no chances. I had another meeting with Evans and the half-breed, and we made up our minds that a signal should be given at night by the firing of five shots from a revolver outside of this rancher's house, but I did not want to attack them, or attack the house until they were in bed.

"So we stowed ourselves away in a little garret where, lying on our backs we could almost touch the roof with our noses; we were packed closely up in the garret for three days, and a part of the third night; it was on the night of the 24th of January, 1893, when we heard the welcome sound of five shots; I do not think it took five minutes for us all to get out of there and get down on the crisp ground; and it did feel good! We walked fast about five miles, and there we were met by Evans, who said that everything was all right, but that we must take off our shoes. We finished the rest of the trip on a run about a mile, and reached the house without any serious difficulty. Rodgers' house was a 16x10 ft. log house that had a door in the center, one room upstairs a little less than a story and a half building, with a room upstairs, which was reached through the door at the side of the room downstairs. There was an open stairway leading upstairs.

"Two of us made a rush into the door, and the door went right in, and in less time than it takes to tell it we were all upstairs. George Brown and a man known as Kiowa, really Jim Turner, were in one bed, the furthest from the stairs; the rest of the gang, three of them, were in one bed close to the stairs. Brown and Kiowa, or Jim Turner, commenced firing through the bedclothes; they had both their Winchesters and revolvers right in bed with them, and had their clothes on. These men were silenced, and the U. S. Marshals, three of the biggest of them, jumped upon the other bed and overpowered those men. It was only necessary for us to kill the two, that is, we found one dead, that was Tur-

ner, and Brown was wounded very seriously in the back.

"We got a wagon from the farmer, and had a tedious journey over the 35 or 36 miles to Vinita, and that night we went down to Ft. Smith and left our prisoners in jail there, and the following March they were tried before Judge Parker and he promptly found them guilty and sentenced them to the penitentiary for twenty-five years each. For some reason, unexplainable to us, Judge Parker paroled Bob Rodgers, the leader of the gang, but he went right out again, and was worse than he ever was before; he finally was killed, after he had killed three or four Deputy U. S. Marshals."

Driving Boxes, Shoes, Wedges and Rods

By a General Foreman.

To go into details covering locomotive driving boxes, shoes, wedges and rods, would make it necessary to take up each subject separately at considerable length. Each subject, however, is so closely identified with the others that in a general discussion it is well to bring them under one head. The most important requisite for the proper working of the machine is the spacing of the driving wheels, or the locating of the driving axles with their centers the exact distance apart on each side of the engine and the axles square with the frames.

While the operations which bring about these results are quite simple and can be readily understood by a workman of ordinary intelligence, we often find machinists who have not taken the time to consider the details sufficiently to understand the laying out of the frames, shoes and wedges. We know of shops where permanent centers were located on the main jaws of the frames so that when the engine received repairs again, these centers could be used in order to avoid the small amount of trouble necessary to lay them out again. Years ago, a locomotive frame was not so apt to get out of alignment to the same extent that it is to-day, and, in making repairs to it, we were more particular to know that all surfaces were machined. Now-a-days, we weld frames without removing from position, and, even though modern locomotives have heavy steel frames, we find distortion due to strains of operation.

To properly locate the centers of main axles, we should take a point as close to the back side of the cylinders as possible, find the center of frames and tram from that point to the center of the main jaws, making the marks on frame of equal distance from the center located at or near the cylinders. This should insure the main driving axle being at right angles to the longitudinal center of the locomotive, or as we generally term it "square" with the engine. From these centers, the centers are laid out on the other jaws and then each jaw is laid out to take care of the conditions affecting it. On some engines the laying out of main jaws must be on the inside of frames and then transferred to the outside surfaces. If this can be avoided, as we frequently find it can, the operation is simplified by making tram marks on the outside surface only. It goes without saying that in addition to having tram marks located proper distances longitudinally, that they should also be the same vertical distance from center of axle. Generally, this can be taken by measuring from tops of frame.

It was not so many years ago that it was the practice in some shops to lay out the shoes and wedges, put them in position and try each driving box in its jaw to make certain of correct workmanship. To-day, we cannot take so much time. We bore the driving box brasses so that the center is equally distant from the shoe and wedge face of box and the men who lay out shoes and wedges merely require the size of the box to go ahead with their work. If the boxes do not have brasses bored centrally, the operation is made more difficult as we must then locate the distance from the center of brass to shoe and wedge faces and use these measurements in laying out the shoes and wedges for planing instead of using one half the size of boxes as would be the case if brass were bored centrally. After shoes and wedges are planed, they should always be placed in position temporarily in order to tram them and know that the laying out and the planing have brought the desired effect.

Many railroads are using a brass shim on shoe and wedge faces of driving boxes in order to have a more easily lubricated surface and to avoid planing the boxes properly to parallel the two surfaces. There is a variation of opinion as to the benefits derived although the majority favors the brass shims on the steel boxes.

It is as important to have the side rods trammed to the proper length between centers as it is to have the driving axles spaced properly, the length between centers of axles of course being the same as the distance between crank pin centers of the same pairs of driving wheels. It takes but a slight variation between the rods and the shoes and wedges to make serious trouble, causing the engine to ride hard, making a jerk as it passes the dead centers, causing pins to run hot and contributing largely to broken axles, frames, crank pins, etc. Failure to have the engine in tram is responsible in the majority of cases for the wearing of flanges. Some engines will run on a crooked road with little flange wear, while others can be kept in service but a short time without renewal of tires or having them turned for proper flanges.

It is important for engineers to give these matters careful thought in order to more intelligently make out work reports, as they have the opportunity

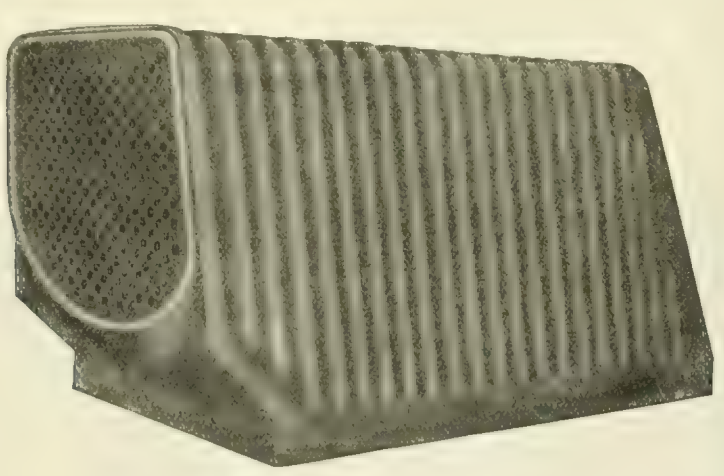
QUEBEC FROM THE ANCIENT CITADEL.

of determining the cause of trouble to better advantage than repairmen in many cases. The locomotive engineer before taking charge of an engine must pass rigid examinations on train rules and matters pertaining to the air brake and machinery. The questions on the latter two subjects, as a rule, can only indicate his knowledge in a general way. For instance, we have known men to pass a perfect examination on a compound locomotive, who never had any experience on one, and who had merely inquired about the answers to the questions it was known would be asked. These examinations are useful, but should not be considered as the final requirements by men who desire to be successful engineers.

Conditions change rapidly. We can only expect to progress by giving our chosen calling the study needed, for if we are not to progress, we must go backward, there is no middle course.

Flexible Tube Plates.

Various plans have been devised to overcome the rigidity of the straight firebox sheets and the plain staybolts and in locomotive boilers both in this country and in England. The Vanderbilt corrugated firebox, is an example of another effort in the same direction. This box, of course, dispensed with the staybolts entirely, but was limited in the firebox and grate area. Flexible staybolts are being extensively used, and various attempts have been made to relieve the expansion and contraction of the side sheets by flanging. A departure from all the previous methods is found in what is called the Wood corrugated firebox, with an ogee on each end encircling the crown, as well as the sides, which is shown in our illustration.



CORRUGATED FIREBOX WITH FLEXIBLE FLUE SHEET.

Three large consolidation locomotive boilers, each 80 ins. in diameter, having 458 tubes 15 ft. 6 ins. long each, are being manufactured for the New York Central Railroad. These boilers are fitted with the fireboxes and tube plates, the first of which was tested to 250 lbs. water pressure, and 260 lbs. steam pressure. The pitch of the corrugations of the firebox is 5 ins. There is a flat portion between each corrugation to which the regular staybolts and crownbolts are applied. The firebox is ⅜ in. thick, being same as is ordinarily used. The tube plates are ½ in. thick, and flanged with deep recesses around the edge, but the riveting edge is carried up to the highest point of the ogees and extends around the crown and sides so that the same number of flues can be used as with the plain tube plate in the ordinary firebox. The flexible back head and tube plate can be used with advantage with the regular form of plain firebox, if it has the ogee on crown and sides as in corrugated box. This is for the purpose of preventing tubes leaking and relieving the tension on the staybolts. In each boiler the corrugations are carried over the crown portion and down the sides to within one staybolt space of the mud ring. The firebox has the regular mud ring and water space.

The flexibility of the corrugated back head and the tube plate allows the tubes to expand and contract and is intended to prevent the tube beading being pulled out of position on the tube plate. Vertical expansion of the tube plate is also provided for, and the tension on the mud ring near the tube plate is considerably relieved. The contraction and expansion of the box is divided equally between the staybolts. The manufacture of a locomotive firebox with the sides and crown completely corrugated and ogeed at each end encircling the crown, as well as the sides will be recognized as a difficult piece of flanging, but it has been accomplished by Mr. W. H. Wood, of Media, Pa., as the result of his experience in the manufacture and use of hydraulic machinery for locomotive boiler shops.

The results with the three corrugated firebox boilers on the New York Central will be watched with interest by all the railroad officers. The inventor claims 30 per cent. increase in heating surface, and and increase of strength of 50 per cent. It is said that from 300 to 350 less staybolts are required with this firebox than is ordinarily the case.

Heat Representing 600 Million Million Vibrations per Second.

It is a long time since scientific investigation began to advance the theory that heat is caused by the motion of the molecules composing a substance. There was for a time some hesitancy about speculating on the speed attained by the individual molecules, but studies connected with radium have encouraged investigators to express themselves quite frankly concerning molecular velocity.

A recent book on radium, dilating upon molecular motion, says: The movement may be of elastic change of shape as with a rubber ball; of vibration, as in the ends of a tuning fork; of rotation like that of a top; or where there is free space, of translation from place to place, as with a bullet. Two or more of these kinds of movements may be combined. But what is certain is that all molecules are constantly in movement, which we call, for convenience, vibration. The molecular vibrations are exceedingly energetic. In a substance which is incandescent, or white hot, the molecules vibrate at the rate of 600 million million times a second. But the energy of vibration varies with the heat, being greater when a substance is hotter, less when it is colder. The energy of vibration is in fact itself the heat of a substance.

That is a wonderful statement, and one which ought to afford much thoughtful entertainment to people who have the privilege of glancing into locomotive furnaces when the fire is at a white heat. They might come by practice, aided by a scientific hand book, to describe the condition of the fire by the molecular vibrations. We may come to hear an engineer exclaim, "Jim, that fire has got down to 350 million million vibrations per second. Shake the grates," or the traveling engineer might get out a spectrum that will indicate through the light reflected from the fire, the exact number of vibrations the fireman is able to keep constantly in evidence. There is no estimating the vast utility that may be developed from increased familarity with molecular vibrations.

Not enjoyment and not sorrow is our destined end and way, but nothing teaches earnest men so many things as sorrow. If you fail in one examination the sorrow of rejection may stimulate exertion and renewed effort that will end in success.

General Correspondence

Railway Scenes in Queensland.

Editor:

I am sending you a number of photographs of scenery on the Cairns-Kuranda section of this line. If any credit is to be given for them then the Station Master at Kuranda should get it (Mr. G. Wreide). They were all taken by him. He is a self-taught man, as far as photography goes. But before I go any further I think it would be as well to let your readers know where Cairns is. It is a rising seaport town on the coast of Queensland. Queensland is the northeastern portion of the continent of Australia and has an area of 668,000 square miles. Cairns lies about Lat. 17 S. and Long. 146 E. This place has been settled for about 30 years, but it is only within the last 10 years that it has started to come into prominence.

The railway was started in 1887 for a place called Herberton, a great mining centre then, but in 1893 construction stopped at Mareeba, a point halfway between Cairns and Herberton. Owing to the nature of the country, an idea of which can be obtained from the pictures, it took three years or so to construct the first two sections to the twenty-third mile.

In 1898 a company called the Chillagoe Co., obtained concessions and extended the line from Mareeba 92 miles through all mineral country to Chillagoe, and erected smelters there. This made a big difference to the Cairns-Mareeba section. The traffic increased enormously. The principal minerals found here are tin, copper, gold, wolfram, bismuth, molybdenite, black rutile. In fact, nearly every mineral known has been found in that stretch of country, although not all in paying quantities. To return to the Cairns' line I must tell you that it is a State railway. Most of the railways in Queensland are owned and worked by the government. The gauge is 3 ft. 6 ins. laid with 60 lb. rails spiked to sleepers laid about 2 ft. apart. The locomotives are all after the American type, i. e., outside cylinders and Stephenson link motion. I will send photographs of different types here later on. The heaviest is about 57 tons 15 x 22 ins. cylinders, 4-6-0 type, tender 8-wheel bogie and capable of carrying 1,400 gals. water with about 5 tons of coal. Diameter of driving wheels range from 3 ft. 9 ins. to 3 ft.

The grades are very heavy on the first 20 miles of the line, Cairns to Kuranda, varying between 1 in. 50 and 1 in. 60 with 4½ and 5-chain curves thrown in. The pictures are all taken from this part of the road, which rises from almost sea level to 1,100 feet in 13 miles. The scenery along it is lovely, and visitors from all parts of the world admit it to be so. Kuranda, just past the Barron Falls at the top of the range, is a regular winter resort for people from Melbourne, Sydney, Adelaide, and in fact everywhere, because the winter climate is lovely. After you leave Kuranda the line breaks into the mineral country and continues through it to Mareeba. In 1903 the line was extended by the government to the Atherton Scrub to open it up. There is magnificent timber in this scrub, the cedar trees, 18 to 20 ft. girth, being common. Other timbers are silky oak, silkwood, pine, maple, rosewood, beech, and others that I do not know the names of.

This year the government has started to extend the line into Herberton, where it was intended to go 20 years ago. Of course there were settlements in Atherton and Herberton in 1887, but they made no progress, because there was no railway communication. These roads mean a big thing for Cairns. The harbor at Cairns is a lovely harbor, and easy of access.

The locomotive I write of has 15 x 2[illegible] in. cylinders, and it is of the 4-6-0 type; driving wheels, 3 ft. The photograph

BARRON WATERFALL ON THE CAIRNS-KURANDA RAILWAY IN QUEENSLAND.

gives you a good idea of the type of rolling stock on this line. I forgot to mention that the Westinghouse brake is fitted on all the stock.

In conclusion I hope that these photos will be acceptable to your readers. At present out here the papers are all full of the projected visit of the American fleet, but we will see none of them; we are too far away out in the back blocks, if I may put it that way. Wishing your paper every success,

E. W. Barker,
Engineman Cairns Ry.
Cairns, Queensland, Australia.

Extension Piston Rods.

Editor:

We note that the practice still prevails both with railway companies and builders, of applying extension piston rods. I would like to have an expression of opinion and experience in regard to the advisability of perpetuating this practice or using extension piston rods on pistons of any diameter in locomotive practice. We have had an experience in respect to the extension piston rods, the particulars of which could be brought out later.

Master Mechanic.

[We should like to receive notes of experience with extension piston rods from our readers. Several years ago there was some discussion of the subject in our pages and there was decided diversity of opinion concerning the value of the device. Much new experience with heavy pistons and the method of supporting them has been enjoyed since that time and we would like very much to learn about the lessons of the extended experience.—Editor.]

Variable Exhaust Nozzles

Editor:—

On page 469 of November number of Railway and Locomotive Engineering is an article referring to the use of ex-

ROBB'S MONUMENT, NAMED AFTER THE RAILROAD CONTRACTOR.

panding (variable?) nozzles on locomotives, and lamenting the fact that if railroad companies put them on their engines they would not be used. "'T is true, and pity 't is, 't is true." There are many appliances placed on locomotives that are useful and good. The "variable exhaust" and notches in the reverse lever quadrant are two of them. I have used both of them and have seen them used by others. In days when each engine had a regular engineer, I have met with engines on which the variable exhaust was so corroded that it could not be used, and gradually closed to its smallest diameter. Reverse lever quadrant showed wear only in notches at full stroke, and one or two others a little up towards the notch called "out of gear." The variable exhaust is one of the most beneficial adjuncts to the locomotive, yet how few, if any, are now to be found on the locomotive? The automatic damper in chimneys of stationary boilers are similar to the variable exhaust, and how many such chimneys can be found without them, or not in working order? It is not a question of leading a horse to the water, etc. Why the variable exhaust is not used, nor the quadrant of reverse lever only worn in three or four notches, is because so few

WATER TANK AT STONY CREEK.

—very few—railroads have got a Jim Skeevers engineer, and "Old Calamity" for superintendent; the one to dare to give an idea, the other to put it in force.

If orders for the use of some new device were issued in a form to appeal to a man's feeling of pride, and not so mandatory as to be offensive, and then a close and honest watch kept on the carrying out of the order, and strict justice given to each man in accordance with his merits, results would come, both surprising and pleasant.

The writer took a Wootten firebox engine, No. 885, on exhibition over several Western railroads. She was equipped with a variable exhaust. On the division between Las Vegas and Pecos none of the engines had it. On the first trip out I set the exhaust about midway; it had a range of $5\frac{1}{4}$ to $6\frac{1}{2}$ ins. I had a younger engineer to run the engine. The engine was steaming finely, and when we struck a heavy grade—grades and curves were all posted by signs—I stepped to right-hand side and opened exhaust full. The almost jump the engine made startled both engineer and fireman. It was a pleasure to me to see the interest that engineer took, when he had got a little practice, in holding the gauge pointer on the line of limit of Pop. One evening I was asked to slip over to the

VIEW OF GLACIER ROCK.

roundhouse. I did so, and found my man, with about a dozen engineers and firemen, teaching them all about variable exhausts.

Some of my experiences on that trip were interesting. The engine was to demonstrate the burning of slack bituminous coal. At Omaha sideboards 18 ins. high were built around the top of the tender, cars of coal were sent out on the line to spur switches, giving the impression that coal would have to be taken on en route. The engine made three round trips as helper to passenger and freight trains between Omaha and Summit; then started with a way freight for North Platte. I think it was 156 miles. We then took on four tons of coal at a regular station and had six and one half tons left on arrival at North Platte. At Laramie we were due to go out at 10 o'clock a. m., but on account of crew not showing up (they were afraid they would have to load coal along the line) we did not get away till 6.30 p. m. At Medicine Bow, I think it was a coal station, one of the brakemen came to the engine and asked me where we would take coal. When told not before we reached Rawlin, he called another of the crew and they had a little swearing match together because they had lost a daylight run on account of hiding away from an engine that they were told took on coal every 10 or 15 miles. We had no further trouble getting crews.

At the Pittsburgh convention, where I was a visitor, a delegate from the Union Pacific Railroad asked me if I had not brought one of them dirt burners to the U. P., and said he had worn his knees bare in praying to God to curse me in every bone, nerve, and muscle and the flesh of my body. He said a man couldn't shut his eyes a minute or the fire would go out. He was a fireman when the wide firebox

was introduced on the U. P. I told him he must be one of those of whom the good book says "The curses of the wicked shall not avail."

E. J. RAUCH.

New York, N. Y.

Cylinders and Superheated Steam.

Editor:

Having read with considerable interest the article in the November issue of RAILWAY AND LOCOMOTIVE ENGINEERING, by Mr. F. P. Roesch, it will not be out of place to add a few comments. It should be noted in the first place that failures by cracking in cylinders are most generally due to shrinkage strains produced in casting. The magnificent results obtained fifty to sixty years ago in casting marine and mill engine cylinders of large size is a source of admiration, and was not entirely due

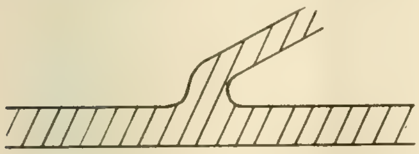


FIG. 1. GOOD FORM.

to the fine quality of iron then used but was obtained by care in details of design, while in these days of quick output, designs are frequently issued and carried out which contain the germs of their own destruction. For instance, it was formerly a general practice when one plate of metal formed an angle with another to unite them with a curved formation as in Fig. 1, probably with large radii both in the fillet and outside the plate to give flexibility in shrinkage, whereas it is common to find them in recent designs of castings as shown in Fig. 2, which not only facilitates the production of shrinkage strains, but also induces spongy metal in the spots at the root of the fillet as indicated. Where conditions permit, it takes but little time and knowledge

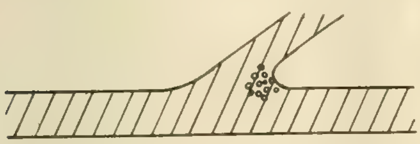


FIG. 2. SPONGY CORNER.

to produce the former result instead of the latter, but when two cylindrical forms are joined together this method of avoiding a lump in the casting cannot be adopted, Fig. 3. In many other respects the new designs of cylinders, especially those for piston valves, appear somewhat more difficult, as well as to have had less care than formerly was bestowed upon the important feature of avoiding the formation of metal in spots, and soft metal is used to cover up the defect.

Many of the defects which commonly occur can be overcome by leaving the cylinder in the sand long enoug to anneal properly. If any such strains exist in cylinders intended for superheated steam, the high degree of heat will tend to permit the metal to give way and relieve the strains just like an annealing process, and thus prevent cracking just as much as it will set up strains in other parts by unequal expansion, but wherever the metal is porous it will tend to render it more so and to produce porosity where there is any molecular movement due to strains being relieved. This action will take place very rapidly with soft cast iron as is in common use, but where hard, tough metal is used there will be but little porosity, and therefore the steam will have less facility for producing solvent action.

Iron in the presence of oxygen without moisture does not easily oxidize, and therefore there will be but little tendency in the superheated steam to attack the iron in that way, but it may be that the affinity between the oxygen and hydrogen of the steam is diminished by the heat, and the carbon or silicon may then be oxidized; or it may be that the sulphur or phosphorus present form acids when heated.

With reference to the tensile strength of castings when heated we have but little information, but it is generally known that wrought iron or mild steel increase in strength up to about 400 deg. F. or 450 deg. F., so that there should not be enough decrease in strength to materially affect the life of the casting.

There are so many conditions affecting cast iron that it would be interesting to learn the analysis of the material that loses 40 per cent of its strength in five years, and also the formation of the castings so affected, for purpose of comparison.

Reading, Pa. ROGER ATKINSON.

Locomotive Foremen's Association.

Editor:

I noticed in your October issue a letter from Mr. A. H. Riddle, of the Colorado Midland Railway, and also one from Mr. A. B. Glover, in your November paper, asking all roundhouse foremen to get together and form an association. I wish to say that we have an

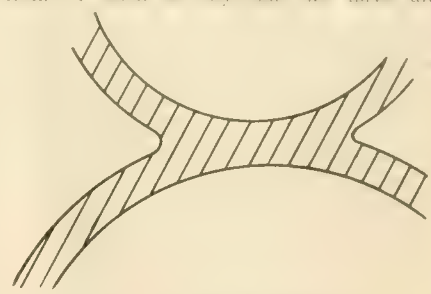


FIG. 3. TWO RIBS JOINED.

association here in New England, known as "The New England Locomotive Foremen Association," which consists of all foremen connected with the locomotive department. I have written to Mr. Riddle, informing him of our association. I would be pleased to hear from any locomotive foremen direct or through the columns of RAILWAY AND LOCOMOTIVE ENGINEERING, who may wish for any information in regard to our association, or who desire to organize an association of this kind. Hoping you will find space for this in your next issue,

FRED D. AVERY.

Keen, N. H. Secretary.

ON THE CAIRNS-KURANDA RAILWAY IN QUEENSLAND, AUSTRALIA

Staybolt Leakage

Editor:

My recent experience is that the staybolts; crown bolts and seam joints leak along the fire line. There are from ten to probably 50 bolts breaking on a trip and these bolts are all examined before starting on a trip and are secure. The experience with the new bolts is the same as with those that had been used before. There is also an accumulation of white matter at the edge where the water leaks from the bolts. This appears in powder form, but when permitted to remain for some time it cakes and becomes very hard. The water we use is mountain water and considered very pure. This situation has existed now for about eight weeks and we know of no satisfactory reason for this condition. I would be pleased to have you discuss this matter in the columns of RAILWAY AND LOCOMOTIVE ENGINEERING. JAMES C. COOK,

Pres. The Catawissa Air Brake Club.

Non-Reflecting Cab Window.

Regarding the description of my locomotive cab window which you kindly published in the May, 1908, issue of RAILWAY AND LOCOMOTIVE ENGINEERING, page 197, let me say: Not having it fully secured by patent at that time I delayed in giving full particulars. I inclose a photograph with dimensions.

NON-REFLECTING CAB WINDOW.

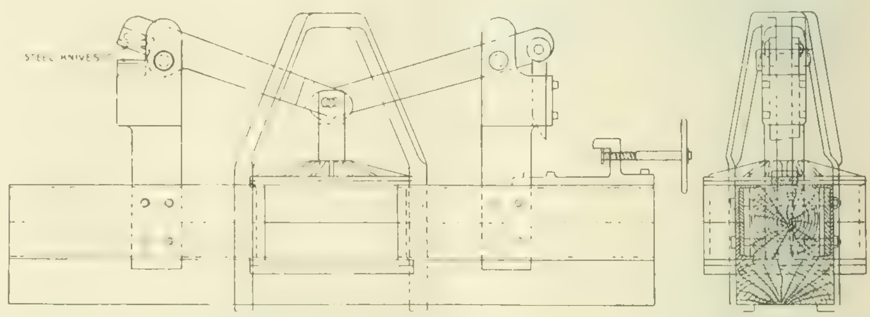
This window is 20 x 38 ins. frame and 14 x 22 ins. glass, set at an angle of 43 degs. The extension is of wood, but it can be made of metal. The angle at which the window is set prevents the glare from the fire hole, obscuring the view of the engineer when the fire door is open. Thanking you for your publication, I am,

Clinton, Ia. C. M. GOODRICH.

Useful Shearing Machine.

Editor:

I am sending you herewith drawings showing a machine, one end of which is used for shearing the heads off the rivets in draw-bar pockets for the purpose of removing the pocket, and the other end is a shear suitable for working over old bolts. It is capable of shearing up to 1⅜ ins. round iron and will shear the heads off two draw-bar pocket rivets



SHEARING MACHINE ON THE B. C. R. & N.

with one stroke of piston, when a pressure of 90 lbs. per sq. in. is used in the cylinder, which is 24 ins. in diameter and 12-in. stroke and is fitted with a packing leather for upward pressure and one for downward pressure. The power is compressed air.

The lower end of the blade for shearing rivet heads is made with one side slightly longer than the other for the purpose of distributing the work required to cut the rivets through more of the piston travel than would be the case with a straight cutting edge on the blade. The air distributing valve, which is not shown on the drawing, is made from a main valve bushing and slide valve from a 9½-in. Westinghouse air pump. The ends of the bushing are closed by means of plates held on by rods extending from one to the other. Into the center of one of these plates the bonnet from an old 1-in. globe valve is screwed, through which the stem passes that connects the slide valve to a suitable lever for operating it. All port holes in the bushing not needed are plugged up. To the bottom of the bushing referred to a brass piece is fastened, into which is tapped two ½-in. pipes, one of which leads to each end of the cylinder. On the side of the brass piece next to the bushing grooves are cut which connect the admission ports in the valve seat with the pipes leading to the cylinder. A slot is cut through the brass, corresponding to the exhaust port in the valve seat, which allows the exhaust to pass to the atmosphere. As these valves are made line and line for air pump use, about ⅛ in. outside lap was added to the valve, which enables the operator to stop and hold the piston at any point of the stroke. The distributing valve is fastened to the side of the cylinder by means of a clamp which passes around the bushing. This machine conveniently located will save considerable handling of material. IRA A. MOORE.

Cedar Rapids, Iowa.

Bank vs. Level Firing.

Editor:

I have been reading the various articles on bank vs. level firing in your valuable paper, with considerable interest. The discussion was started by one connected with Pennsylvania lines, and as I did my first firing on that system 33 years ago, and have fired and run engines in various parts of the United States. I will say, that I never knew the bank system to be a success. For myself I always got better results from level firing and carrying as light a fire as possible, When I was firing it was a poor sign for a fireman to use a hook or slash-bar except when cleaning a fire. It is no way to do to put 8 or 10 scoops of coal into the firebox and then take the hook to stir up.

Smithville, Tex. AN OLD TIMER.

Irrigation Congress.

Editor:

The order of things is being reversed. "Back to the farm; mother earth and God's out of doors," have been the subjects of many articles in magazines and press during the past year, and homeseekers by the trainload are leaving the city, which had attracted them with its tinsel and commercialism, to return once more to the simple farm life, with its health and prosperity.

The reason for all this is irrigation. It has been demonstrated that from six to forty acres is all that one man can properly take care of, in the new order of things, and in the mind's eye we can see the entire country settled like a suburb, a succession of comfortable and happy homes, with nearby neighbors, churches and schools, telephone and trolley, where the farmer elevates him-

self above a drudge and takes advantage of all the refining influence of the highest civilization, together with its health and freedom.

The sixteenth Irrigation Congress just closed at this place has demonstrated to the thousands in attendance, without a doubt, that there is a great future in

SANTA FE PAVILION AT THE IRRIGATION CONGRESS.

store for this Western country, arid it is sometimes called, and this great gathering might justly be termed the opening wedge of the reclamation process which is being inaugurated. The prime factor in this great movement is the Santa Fe Ry. Co., and the exhibits which they caused to be gathered here would do credit to any agricultural or mineral display in the world. Their lines and feeders tap all this Southwestern country, and every section from Kansas to California was represented.

Besides the irrigation products, the dry farming contingent was out in full force, and oats, wheat, alfalfa, etc., from 6 to 8 feet in height, was exhibited, on which not one drop of water had been turned outside of the scant natural rainfall.

Utah had the honor of taking first prize. Their exhibit was large, tastefully arranged, and without a doubt they "got what was coming to them." New Mexico ran them a close second, and even the natives were surprised at the variety and excellence of the products shown. One could tell of 195-lb. squashes, enormous bunches of grapes, bales of cotton, figs, almonds, 8-ft. alfalfa, etc., and no doubt some of our Missouri brothers will sit up and take notice when we mention the apple from Luna Co., which was 19½ ins. around and weighed 39½ ounces.

The Victor Fuel Co. had an interesting exhibit, that of a coal mine in full operation, in which was shown the methods of mining, ventilation, etc.

The combined Irrigation Congress and Territorial Fair lasted two weeks, and every minute was a busy one. Eight bands were in attendance, the Mexican National band of 40 pieces, from Old Mexico, and Held's band, of Utah, being prize winners, $2,500 was divided into three prizes in the baseball tournament, the Navajo Indians gave their celebrated fire dance, and almost the entire garrisons of U. S. soldiers from Forts Logan and Wingate, together with the Roswell Military Academy Cadets, were here with fancy drills, etc.

Albuquerque has taken a long breath and is trying to get back into the old routine of business, but it will be many days before the incidents of the recent weeks will cease to be the principal topic.

ALLEN E. NYE.
A. T. & S. F. Ry. Co.

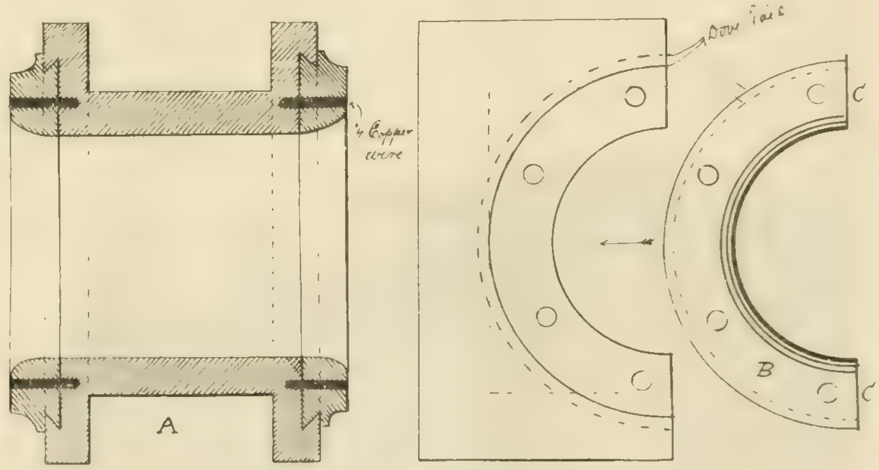
Albuquerque, N. M.

Lateral Play in Rod Brasses.

Editor:

Some time ago we had occasion to take up the lateral play in some rod brasses, and the following method was adopted as per inclosed sketch. A, represents the rod brass with the side liners as they are put in. The brasses are bored and a dovetail is turned on the sides, and the half ring B is put in sideways, as shown in the sketch. The liners are made in rings and cut in two at C, thus two rings or four halves will suffice for one set of brasses. In addition to this the liners are kept from turning by putting in ¼ in. copper pins. The first set of brasses we fixed in this manner ran for some four months, when they were worn out, and new liners, which we kept on hand, were put in. The dovetail keeps the liners from falling out and the pins keep them from turning.

C. WILHELMSEN,
Kentwood, La. Master Mechanic.



ROD BRASS WITH DOVETAIL PIECES FOR WEAR.

Keep Abreast of the Times

Editor:

In the year 1889 I began my career as a locomotive fireman on the Michigan Central. Soon realizing the fact that it was very monotonous groping in darkness for the art of firing a locomotive, I purchased a periodical entitled "Locomotive Engineering," published by Angus Sinclair, which I studied thoroughly and put its theories into practice, and found it a great assistance to myself as well as a great financial benefit to the company that employed me. I thought then and am still at a loss to know why it is that railroad companies hire new firemen and do not furnish them with one of those books treating on their vocation from start to finish. It looks to me like robbing Peter to pay Paul for a company to deny the first cost, when with a knowledge of the facts contained in these books a man could save the price in the first 25 miles of firing a locomotive, where without this knowledge he may make 25,000 miles without the least idea of economy or skillful firing. Perhaps some of your readers will remark the writer is no practical engineer; if so, I would suggest a production of my record on the P. M. R. R.

JAMES RYAN.

Grand Rapids, Mich.

Derailment of Tenders.

Editor:

I have read with pleasure the able articles which have appeared in recent issues of your valued paper relative to the derailment of tenders and the causes and cures for same. The complaint seems to have been very general and the causes many and varied. Now that so many remedies have been suggested we may expect the number of derailments to be greatly diminished in the near future. As I am led to believe that the opinions of subordinates are in a great many cases taken as criticisms of those in authority I do not want my name to appear in print, but as I had a hand in provoking the discussion I am glad to see it go the rounds.

None have seen fit to take up the question of increased friction and greater tendency to derailment from the use of steel-tired wheels, so I presume there is nothing in it. In connection with derailments I may say that we have had considerable trouble with pony truck wheels getting off the track. I believe that this is also a general complaint, especially on

consolidation engines with a long wheel base. There has been a great deal of controversy in the official family, and it has been decided to reduce the distance between the lower holes in cradle by 2 ins., making it 25 ins. on the bottom holes and 23 ins. from centers on top. I never could see the reason for having inclined hangers, and will be pleased to hear from you or any of your correspondents, whether this is the general practice and what is thought of it.

Pittsburgh, Pa. L. E. READER.

A Voice from the Land of the Nile

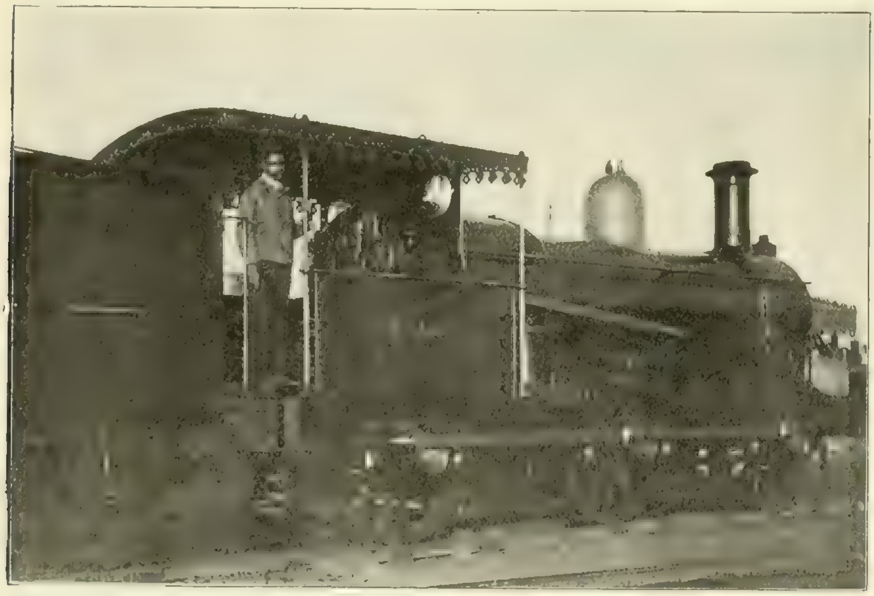
Editor:—

Your letter dated the 29th ult. has been received and I beg to herewith send you my photograph as well as the photograph of one of the engines standing in our shed yard.

The person standing on the engine is myself. You will please observe that I am a young man, about 24 years old (born at Damietta, 7th November, 1884). My father was one of the drivers who first drove on the steam locomotives in the early days of our railway. He departed to eternity in July, 1903, after a long service of 40 years on the foot-plate of several engines. I have joined the service of the locomotive department from the 1st of August, 1903, and being attracted by the beauties of mechanics I always like such study.

I hope, sir, you will succeed in everything you do. No doubt I consider myself one of your men, so ever faithful and obedient. My best wishes and hearty respects to you and the members of your company.

MOHAMMED HAFEZ,
Engineman, Tanta Loco. Dist.
Tanta, Egypt.



LOCOMOTIVE ON THE EGYPTIAN STATE RAILWAYS.—MOHAMMED HAFEZ, ENGINEER.

Care of the Air Pump.

Editor:

The following may be useful to some of your readers. A good way to do when you have to remove and renew the reversing stem of a 9½ air pump, is to unscrew the reversing stem cap and take the plug out of the bottom head of the pump and hold the stem to lift and pull out. This method saves breaking the top and bottom joints of the air pump.

The air pump should be shut down when the engine comes in on the ash track. If it is left working, it gets a good deal of dust and grit, which causes the pump to run hot. Do not wash out the pump with lye-water when the pump has been reported running hot, as the lye does more harm than good, but examine the air valves and packing rings. Loose packing rings will make a pump run hot. Too much lift of the air valves will make a pump run hot. Too much oil will cause port holes to clog up and then the pump cannot discharge air as fast as it can take it in, and the pump runs hot.

All inspectors of air apparatus on engines, should see that all joints are tight on the engine before it leaves for its run. See that the brake valve is all right and that the gauge for high-speed brake, train line 110 lbs, main reservoir 130 lbs. See that the triple valves do not blow at the exhaust. See that the signal registers 40 lbs., and then the engine is ready for the road. If all inspectors would do these things, the brake power on a lot of roads would be all right.

Engineers hould carry with them an extra reversing stem cap in case of losing one on the road. If the air-pump throttle leaks badly it is a good plan to see that the pump is well oiled.

JOHN H. HOWARD,
Air-Bk. Inspector, N. C. R. R.
Baltimore, Md.

MOHAMMED HAFEZ, AN EGYPTIAN LOCOMOTIVE ENGINEER.

Shop Inspection

Editor:—

To the writer the question of inspection of the finished product seems to be one which has not received merited attention in the discussion of the different problems which are confronting the manufacturer of to-day. The necessity of inspection is one of the additional burdens, if it may be termed such, which has had its inception in the subdivision of operations, and therefore operators, which together go to make the finished article.

As is well known, the all round mechanic of twenty years ago has given way to the specialist. Previously a well developed man in a machine shop could perform any operation or erect any part of the machine which the concern by whom he was employed wished to turn out. Now he has been replaced by the specialist, who, while being an expert on his particular job, would be completely at sea if put at another man's work.

While the evolution of the specialist has come in response to an economic demand, it is apparent to any thoughtful foreman or superintendent that the quality of the specialist, for he has come to stay, can be much improved. This improvement can be carried out in the treatment of both the apprentice and the finished workman.

The writer has observed in different shops that the apprentice boy, as soon

as he has shown any ability in a particular line, is very apt to be shunted from his proper course and made a permanent fixture at the particular job on which he has demonstrated his ability. How much better it would be if he were given the chance to move from job to job until his four years had been served, and then the company would have the foundation of an "all-round" specialist who would be able to understand the subsequent harm which would be the result of careless workmanship.

The finished workman is bent on earning his daily wage and oftentimes is inclined to regard quantity rather than quality. This is especially so under the piece-work system which is so common in our shops of to-day. While increased output is the ultimate aim of all the systems of wage payment formulated from time to time, in many cases it would be far better if some of the energy and money expended in their formulation were saved and applied to the practical working out of the derived plans. How often does a large corporation spend a great sum in the hiring of specialists to perfect some new system and then leave the application of the system to a low-priced, inefficient man. The result is that the system does not reach the workman in the desired form, and often he is obliged to sacrifice quality for quantity.

The workman should be paid a fair price for his work and then be given to understand that it must be done properly and that he will be held responsible for the correctness of previous as well as his own operations, thus making each man his own inspector. The

SURPRISE CREEK BRIDGE, QUEENSLAND.

habit of performing work on a piece which has previously been ruined should not be tolerated, and the management should clearly give the workman to understand that this is the case. It is here that the foreman comes in, in that it is his duty to set the standards for the workman and then to see that his standards are being lived up to.

The foreman's interests extend further, in as much as while the workman is looking for individual production he is looking for collective production, that is the shop output. While the security of the foreman's position depends upon the getting out of the work, he should never do so at the sacrifice of quality, for the success of "workman inspectorship" will depend upon the rigidity with which the principle is applied. The foreman should not lose sight of the fact that he, not the shop inspector, is responsible for any defect which may be discovered in the finished product. Often it would be well for him to consider some of the questions which arise from the purchaser's viewpoint, and even though it may mean additional expense for the time being, in the long run it will pay both him and the company, for the reputation of good workmanship is an invaluable asset.

There is scarcely an engine turned out by the average locomotive works which is not delayed from five to ten hours because of some piece of careless workmanship which in most cases has passed through several hands and which could have been remedied if the successive workmen had so wished. The man in the erecting shop puts up a piece of work which he knows is not right, all the time saying to himself, "The machine shop sent it over this way so it is up to them." "Why didn't the inspector see it, what is he around here for?" "I am not paid for running over to the machine shop, the company is making money on me with this job," and the like. This is just the spirit which prevails in the average shop today, the elimination of which would be more valuable, considered from a dollar standpoint, than the installation of several systems. The tendency of workman inspectorship may be said to be towards idealization but nevertheless it is an ideal possible of attainment, and it must be remembered that an ideal is one of the prime requisite of success.

CARL S. WAGNER.

Paterson, N. J.

Not as Slow as Pard.

Editor:

Your publication loses none of its luster. My tardiness in my remittance reminds me of my chum of the 70th, who was unmercifully slow. The squire, as the foreman was called, gave about a bushel of old fashioned studs

"THE CORN COBS THEY GROW BIG OVER THERE."—NEBRASKA CORN.

to make, cut off of the bar by the old chisel and sledge. No saws in those days. When pard saw the heap, he said, "J. S. Squire, have I got to make all of them?" Squire looked over his glasses, very seriously and said, "if we live long enough."

S. F. PEERS.

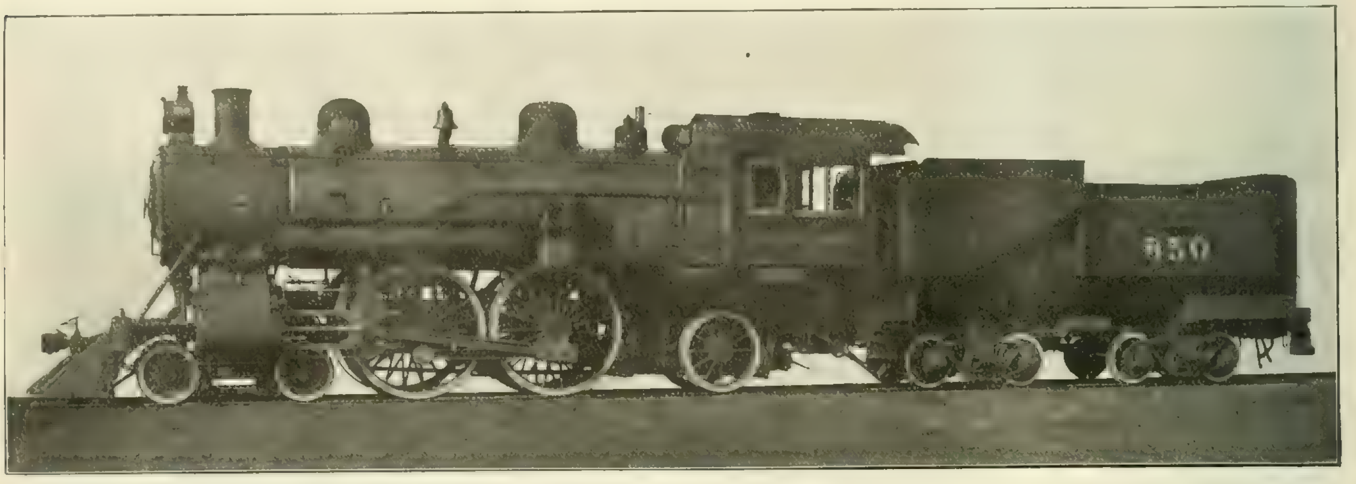
Montour Falls, N. Y.

Rose to the Occasion.

A traveler who put up for the night at the leading hotel in a small town had, before retiring, left explicit instructions to be called for an early train. He was very much in earnest about the matter, and threatened the clerk with all manner of punishment if that duty was neglected. Early in the morning the guest was disturbed by a lively tattoo upon the door. "Well?" he demanded sleepily. "I've got an important message for you," replied the boy. The guest was up in an instant, opened the door, and received from the boy a large envelope. He tore open the envelope hastily, and found inside a slip of paper, on which was written in large letters: "Why don't you get up?" He got up.—*Penny Pictorial.*

Engines for the Associated Lines.

The American Locomotive Company have recently completed the last of an order of 125 locomotives for the Harriman Lines. This order included forty-three Consolidation locomotives, thirty Moguls, ten Atlantics, twenty-four Ten-Wheelers, and eighteen Switchers, all of which were built to designs and specifications which have been adopted as standard for all the roads included in this system. The railroads whose engines form the subject of our illustrations are now part of what is generally called the Harriman System. This standardization of the different classes of locomotive equipment of the Associated Lines was inaugurated in 1902. At first the specifications covered four types of locomotives: the Atlantic and Pacific type passenger, Consolidation freight and heavy Switchers. Since that time, however, standard designs for ten-wheelers and Mogul types have also been adopted. The purpose of thus standardizing the various designs was not only to secure interchangeability of details between locomotives of the same type, but as far as possible, without sacrificing anything of the efficiency of the machine, to adopt standards which would be common to all the different types required on the different lines. How well this purpose has been accomplished is shown by a comparison of the designs of the Atlantic and Mogul type engines included in the above mentioned order.



J. W. Small, Supt. of Motive Power — ATLANTIC TYPE FOR THE FERROCARRIL DE SONORA. — American Locomotive Company, Builders.

The 4-4-2 type of engine which we illustrate was designed for burning bituminous coal; while of the Moguls, fifteen are oil burners and the remainder, one of which is shown in our half-tone illustration, used coal as fuel. Except for the changes in design incident to the use of oil for fuel, the two classes of Moguls are identical in design. The Atlantic type engine had a total weight in working order of 197,000 lbs., of which 100,400 lbs. is carried on the drivers, while those of the Mogul type have a total weight in working order of 179,200 lbs., with 152,500 lbs. on the drivers. It might be mentioned here, in passing, that this weight places these last mentioned engines among the heaviest of their type ever built, the only Moguls having a greater weight built by the American Locomotive Company being those for the Vandalia Line, which weighed 187,000 lbs., and are the heaviest of their class in the world. With the larger diameter driving wheels of the Atlantic type engines, it is possible, however, in spite of the smaller weight on driving wheels of this type, to use the same boiler pressure and same size cylinders for both classes of engines.

Each class is equipped with cylinders 20 ins. in diameter by 28 ins. in stroke, provided with piston valves 12 ins. in diameter. The valves of each type have a maximum travel of 6 ins. and have 1 in. steam lap and 1-16 in. exhaust clearance and the lead in full gear of 3-32 of an inch.

The motion in both cases is indirect, but in the Atlantic type engines the rocker shafts have been placed ahead of the forward driving wheels, the link is connected with the downward extending arm of the rocker shafts by means of a transmission bar which straddles the front axle. As a result of this arrangement, the same cylinder heads, valves, valve bushings, pistons, piston rods, crossheads, connecting rod bearings, rocker shafts, eccentric straps and eccentrics are common to both classes of engines.

The cylinders of both engines here illustrated, have the same spread, viz., 88 ins., and the same distance, 43 ins. between frame centers, and take a common frame section, so that the deck plates, reverse shafts and driving boxes are common to the two classes.

Both boilers are of the straight top, crown bar type and have the same diameter and the same inside dimensions of fire box; although in the case of the Mogul, the mud ring slopes down at the front end and the throat sheet is vertical, while the mud ring of the Atlantic type is straight and the throat sheet is sloped. With the diameter of the boilers the same for both classes, it is possible to use the same smoke-stack, smokebox, front and door, dome ring base and cap, throttle pipe, dry pipe elbow and end and minor details. At the same time a comparison of the amount of heating surface in the two designs shows that this standardization of the boiler design has been effected without any sacrifice of the efficiency of either class of engine for the particular class of service for which it is intended. With the greater length of flue of the Atlantic type, a total heating surface of 2,649 sq. ft. has been obtained, as compared with 2,102 sq. ft. of the Mogul type. This gives a ratio of tractive power multiplied by the diameter of drivers to total heating surface, or, in other words, factor of 717 in the passenger engine which, although not as low as in some other recent examples of engine of the same type, is about the average and would indicate the large boiler capacity for sustained high speeds. Some of the other more important details which might be mentioned as common to both classes of engines are steel cabs, sand boxes, injectors, injector checks, throttle levers, engine truck axles, engine truck boxes and grate bars.

Each engine is provided with a Vanderbilt type of tender with a cylindrical tank having a capacity of 7,000 gallons of water and a fuel capacity of fourteen tons. The tender frames are of angle irons and the tenders are carried on two four-wheel trucks of the Andrews cast steel side frame type.

Some of the tender details, wihch are common to both types, are as follows: axles, bolsters, journal boxes, truck center plates, springs, side bearings, wheels, air brakes, tender frame body bolsters, and draw gear.

Specification of the 4-4-2 engine for the Sonora Ry.—Cylinders, type simple with piston valve, diameter, 20 ins., stroke 28 ins.; tractive power, 23,506 lbs.; wheel base, driving 7 ft., total 27 ft. 7 ins.; wheel base, total, engine and tender, 57 ft., 3 11-16 ins.; weight, in working order, 197,000 lbs., on drivers 100,400 lbs.; weight, in working order, engine and tender, 339,380 lbs.; heating surface, tubes 2,475 sq. ft.; firebox 174 sq. ft., total 2,649 sq. ft.; grate area, 49.5 sq. ft.; driving journals, 9 x 12 ins.; engine truck journals, diameter 6 ins., length 10 ins.; trailing truck journals, diameter 8 ins., length 12 ins.; tender truck journals, diameter 5½ ins., length 10 ins.; boiler, type straight top, first ring 71 3-8 ins. diameter outside; boiler working pressure 200 lbs.; firebox, type wide, length 108 ins., width 66 ins.; firebox, thickness of crown, ⅜ in., tube ½ in., sides ⅜ in., back ⅜ in.; water space, front, 5 ins., sides 5 ins., back, 5 ins.; crown staying, radial tubes, steel, number 297, diameter 2 ins.; tubes, length 16 ft., gauge .125 m.m.d.g.; driving boxes, cast steel; New York; brake, pump 1 left-hand, 2 reservoirs, 20 x 133 ins.; engine truck 4-wheel swing motion; piston rod diameter, 5¼ ins., piston packing 3 snap rings; smokestack diameter 20 ins., top above rail 15 ft. 2½ ins., tender frame, angle iron; tank, style cylindrical (Vanderbilt type); tank, capacity, 7,000 gallons; capacity fuel, 14 tons; wheels, driving diameter outside tire 81 ins.; material, cast steel; wheels, engine truck diameter 33½ ins.; kind, rolled steel; wheels, trailing, truck diameter, 51 ins.; kind, cast steel; wheel, tender truck diameter, 33½ ins.; kind, rolled steel.

Descriptive specification of the 2-6-0 engine for the Cananea, Yaqui River & Pacific.—Cylinders, type simple with piston valve; diameter, 20 ins.; stroke 28 ins.; tractive power, 30,222 lbs.; wheel base, driving 15 ft. 2 ins.; total 24 ft.; wheel base total, engine and tender 53 ft. 2 11-16 ins.; weight, in working order 196,200 lbs., on drivers 152,500 lbs.; weight, in working order, engine and tender, 313,000 lbs.; heating surface, tubes 1,956 sq. ft.; heating surface, firebox, 146 sq. ft.; heating surface total 2,102 sq. ft.; grate area 49.5 sq. ft.; driving journals 9 x 12 ins.; engine truck journals, diameter 6 ins., length 10 ins.; tender truck journals, diameter 5½ ins., length 10 ins.; boiler type, straight top, first ring 71⅜ ins. outside diameter; working pressure 200 lbs.; firebox, type wide, length 108 ins., width 66 ins.; firebox, thickness of crown, ⅜ in., tube ½ in., sides ⅜ in., back ⅜ in.; firebox, water space, front 5 ins., sides 5 ins., back 5 ins.; crown staying, radial; tubes, material Shelby seamless steel, number 297, diam., 2 ins.; tubes, length 12 ft. 8 ins.; gauge .125 m.m.d.g.; boxes, driving cast steel; brake, New York; pump, No. 5 Duplex, 1 reservoir 20 x 145⅝ ins.; and 1 reservoir 20 x 119⅝ ins.; engine truck, two-wheel swing motion; piston rod diameter, 5¼ ins., piston packing 3 snap rings; smokestack, diameter, 20 ins., top above rail 15 ft. 2½ ins.; tender frame, angle iron; tank capacity 7,000 gallons water; tank capacity, fuel (B-1152), 14 tons of coal, (B-1153), 2,940 gallons of oil; valves, type piston, travel 6 ins., steam lap 1 in.; valves, ex, clearance 1-16 in.; setting, lead in full gear 3-32 in.; wheels, driving diameter, outside tire 63 ins.; wheels, driving material, cast steel; wheels, engine truck, diameter, 30½ ins.; kind, rolled steel; wheels, tender truck, diameter, 33½ ins.; kind, rolled steel.

Gravitation Helps.

One of the daily papers in Canada recently announced the intention of the Canadian Northern to build a railroad from their coal lands in Alberta to the Grand Trunk Pacific line. The press account of the project says that between the Pembina and McLeod rivers, a distance of 50 miles, the grade will be so constructed that the loaded cars of coal will run the whole distance to the G. T. P. line without any locomotive, while one engine will be able to take back all the empty cars. This will considerably reduce the cost of the coal, which will be taken over the G. T. P. to Edmonton, and there shipped out to points on the C. N. R.

What is probably meant by the above statement is that very large loaded trains of coal can be taken down grade and long trains of empties taken up again, which of course reduces the cost of operation; but the way the newspaper account reads there would only be a one way movement of locomotives on the road and there would be nothing to supply brake power to the heavily loaded trains going down grade. Great things can now and then be done on paper.

Hard on Railways.

Commercial travelers will appreciate this story, which is told by one of their number. He had been summoned as a witness in a case at court, his employers having sued a delinquent customer, and the lawyer for the defense was cross-examining him. "You travel for Jobson & Co., do you?" asked the attorney. "Yes, sir." "How long have you been doing it?" "About ten years." "Been traveling all that time, have you?" "Well, no, sir," said the witness, making a hasty mental calculation; "not actually traveling. I have put in about four years of that time waiting at railway stations and junctions for trains."—*Montreal Witness.*

MOGUL FOR THE CANANEA RIO YAQUI & PACIFICO RAILWAY.

J. W. Small, Supt. of Motive Power. American Locomotive Company, Builders.

Railway and Locomotive Engineering

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Locomotive Foremen's Association

Several letters have recently appeared in the general correspondence columns of Railway and Locomotive Engineering concerning the formation of a Roundhouse Foremen's Association, similar in scope and with the same general aims and objects as those of the General Foremen's Association, the Air Brake Association, the International Master Boilermakers' Association, the Master Car and Locomotive Painters' Association, the International Railroad Master Blacksmiths' Association, and the Travelling Engineers' Association. These associations include members from all parts of this country, Canada and Mexico, and the experimental work they do, the papers they prepare, and the discussions which they permit, are beneficial not only to the individual members themselves but to the railways they serve.

In our general correspondence columns this month there appears a letter from Mr. Fred D. Avery which informs our readers of the existence of the New England Locomotive Foremen Association. This is an organization on the very lines suggested by our previous correspondents. The Association was organized November 21st, 1904, and has therefore been in existence for the past four years. The headquarters are in Keene, N. H., and the officers are Mr. L. Morgan, president; Mr. John J. McNulty, vice-president; and Mr. Fred D. Avery, secretary and treasurer, Keene, N. H. All these gentlemen belong to the Boston & Maine Railroad. The objects of this Association, as stated in the constitution and by-laws, read: "The object of this Association shall be the mutual improvement of its members in reducing the cost of the different materials used on locomotives, by exchanging ideas, by means of meetings and the reading and discussion of papers, by the general exchanging of views, so that we may all profit by the experience of others more proficient in our craft, and be of greater value to the corporation employing us and to those for whose interest we labor."

The fees are merely nominal and all locomotive foremen are eligible for membership who have been in active service not less than six months prior to the date of application. Here is an association in working order, with the object of increasing the efficiency of members, stated in just the way calculated to appeal to the locomotive foremen all over the land, and with a wide but reasonable qualification for membership and nominal fees. It seems to us that those who desire, and most properly desire, to see the important and responsible position of locomotive foreman put where it has a right to be in the eyes of the whole railroad world, might take the New England Association as a foundation upon which to build up a society which would equal in usefulness and efficiency any of those which now represent the other departments of railroad activity. We will be glad to hear from roundhouse foremen far and near on the subject of formation of, or rather the wider extension of, the association started four years ago in New England. There should be a large and influential association of roundhouse foremen. This one is at present local, but it is founded on right lines; it can be made to take in the whole country, and suited to a wider field of usefulness.

One of the points touched on by one of our correspondents was that such an association should have a journal of its own. On this point we may say that the other associations, including the Master Mechanic's and the Master Car Builders' Associations, do not publish a magazine. They print their proceedings each year and this volume constitutes the official record of all that is said and done at the sessions held. The publication of a monthly, or even a quarterly magazine, is an expensive affair, and to do it properly it requires the exclusive service of one or more trained men who should be adequately paid. A magazine or journal is not essential in the programme. Railway and Locomotive Engineering stands ready to help in the formation or extension of a locomotive foremen's association, and now, or when formed or extended the pages of our publication are open all the time for the full and free discussion of railroad topics as set forth in the objects of the New England Association. We ask our friends to write us on this important subject or to write the secretary of the New England Association at Keene, N. H., for information about the work already done.

Industrial Revival

It is gratifying to feel and to know that good times are not only coming but that good times are here already. As is well known, the railroads are the first to feel a financial depression, so they are the first to feel the effects of a revival of industry. The interchange of commodities, by which the great arteries of commerce are kept open form a sort of volumetric indication of the industrial activity of the country. From every part of our broad land comes the cheering intelligence that practically every wheel is now in motion, and that many railroad shops are actually short handed, though endeavoring to hire men. Extensive orders are being placed and a new era of railroad activity has fairly begun.

It need hardly be stated that the industrial depression of the last year has been in some respects made really worse than it might have been. This has particularly been the case on some of the railroads where the suspending of skilled mechanics and the running of shops on short time has resulted in a deterioration of the motive power. It will take many months to completely rehabilitate this neglected power. One does not have to be a very skilled engineer to observe that while passenger locomotive have been kept in fairly good running condition upon the chief railways, there is a general need for taking up the lost motion on great numbers of freight engines. Work of this kind cannot be done in a day, and we are not surprised to learn that now, when the needed repairs cannot be longer put off, it is difficult to find mechanics in sufficient numbers to do the work.

We will be surprised if the general revival and extension of railroad work in the railroad shops does not lead to an increase of wages, or what is of equal if not of greater value, a general adoption of shorter hours among the skilled mechanics engaged in the exacting work of construction and repair of railroad rolling stock and mechanical appliances. There is no kind of work requiring more careful attention. Much of the work, especially in repairing, is done under the most trying conditions.

The opportunities for mental improvement and relaxation should be of the amplest kind. The future is full of hope. A brief period of partial depression has taught many lessons and the outcome cannot be other than that of progress in the right direction. Let us hope that the revival of industrial activity will bring with it new resolves to make the most of the opportunities that are coming to us, to the end that we, in our various situations, and to the limit of our various capacities, may rise to higher and nobler accomplishment.

Signal Observance Record

We have before now alluded to what has been called, perhaps for want of a better name, "surprise checking" in the matter of signal observance. The name "signal efficiency test" has been used by some newspapers to designate this system, but these names do not exactly suit the case. In the first place there is no surprise about a signal whether it be in the proceed, caution, or stop position, and signal efficiency refers rather to the maintenance in good working order of the whole signal system than to the obedient observance or the disregard of the signal by those to whom it appeals. The system is not so much a test either, for a test implies a special trial which may or may not be successful. The system is in reality simply a signal observance record, and on a goodly number of our large roads this record has been most satisfactory.

As an example of the kind of record engineers can make under a properly managed signal observance record we may cite the Pennsylvania Railroad. The signal observance record is carried out by the officials who cause the signals to be displayed in various positions, extinguish lights or place torpedoes on the track and then take note of the observance of the signal by the trainmen who first encounter the altered signal. In doing this the officials do not produce a set of conditions which may not naturally arise; they simply do purposely what the weather, or a broken rail, or a derailed car, or a late train may do, and they record the obedience or not of the train first encountering the altered signal.

It has been the pleasing duty of the officials on the Pennsylvania to record the well-nigh perfect observance of signals by the men who are expected to see and obey them. In August last 3,250 alterations were made with the result that 99.25 per cent of the trains which encountered the "light out," torpedo or stop signal took heed to and obeyed the indication. This is an exceedingly high-class performance on the part of the men. In the month of which we speak fourteen divisions of the Pennsylvania reported perfect observance of all block signals, while fifteen divisions were perfect in all other kinds of observance, such as stopping for light out, etc. All divisions had high averages and slight infractions were marked against the men as non observance, so that the record is one of positive observance or disregard. On the Lines East of Pitsburgh the records show that the month of August was practically free from accidents to passenger trains. Out of the enormous number of passengers carried, only two were injured. No passengers were killed in train accidents. There were no derailments or collisions between passenger trains. One collision occurred between a passenger and freight train when both were moving at slow speed.

We mention these facts because we believe that such results show that the men are in earnest and that they recognize the immense importance of safety in the commercial prosperity of the company they serve, and that they maintain this high standard of efficiency not only for that reason but from the more noble purpose of honoring the trust reposed in them by the traveling public. Officials and men on the Pennsylvania are to be congratulated on the August signal observance record.

Flat and Twist Drills.

It is observable in some machine shops that there is a reappearance of the flat drill, not that the flat drill had ever entirely disappeared, but that it is seen more frequently at present than for several years past. It should be generally known that in certain kinds of work the flat drill is to be preferred to the twist drill. Apart from the cheapness of its manufacture, the readiness with which it can be adapted to various sizes and lengths and tempered to cut extremely hard metals, it will be found well adapted to the drilling of holes that are not of great depth and where the exact size is not an important factor.

The flat drill is of decided advantage in cleaning cut holes that are in castings and the cleaning or cutting of which are particularly injurious to twist drills or lathe tools. In grinding flat drills special care should be taken that the cutting lips should be of equal length, with their angle of intersection in the centre of the drill, otherwise the size of the hole drilled will be increased by twice the variation in the length of the cutting edges. The tendency to break the drill is also greatly increased by any such variation.

The twist drill is of decided advantage in deep holes. It has the faculty of clearing itself of chips of any kind of metal, besides drilling a hole of the exact size indicated. It is also tempered to an equable degree of hardness throughout the entire length of the flutes. Great care is necessary in grinding twist drills. An inequality in the cutting edge superinduces an eccentric motion in the drill with a corresponding increase of the diameter of the hole.

A hole made by a twist drill is under all conditions a round hole. In the case of the flat drill there is no limit to the geometrical vagaries its work may exhibit. In grinding a twist drill it should be noted that the angle of clearance should be greater near the center of the drill than at the cutting edges. In relation to the center of the drill the cutting angle should be about 60 degs. Too flat or too tapering a point affects the cutting quality of the drill in a marked degree. Twist drills should not be used for the purpose of increasing the sizes of holes. In such work the tendency to break the drill is very great.

It may be added that in all kinds of drilling work on metals, if there are a number of the same articles to be drilled, suitable jigs or drilling templates not only insure accuracy but require much less time. The tendency toward jig-making is in the right direction, and with jigs carefully constructed and a suitable assortment of twist drills, an approach to perfection can be made that leaves little to be desired.

Utopia or Millennium; Which?

Some four hundred years ago a political romance, called "Utopia," was written by Sir Thomas Moore, an Englishman, describing a country in which people lived under perfectly ideal conditions. Tyranny and injustice were unknown and fruitful fields tilled by willing hands produced abundance of food and raiment for a happy people. All property being common, there was no rich and no poor, but the whole community lived in a state of strict equality which was supposed to ensure universal happiness. That was an old ideal and it has served to amuse many generations.

A new form of Utopia has been vaguely looming in the distance with the extraordinarily mysterious element radium as a promoter. A very striking article by Hudson Maxim, a semi-scientist, appears in the *Cosmopolitan Magazine* for November under the title "Man's Machine-Made Millennium." Everything modern must be machine-made and Mr. Maxim's conception is a true product of the latest industry. The editor digests the article thus:

"It is a wonderful picture that Hudson Maxim has conceived in his scientific

mind and thrown on the screen in this article. Daringly peering into the future, he makes one gasp as he predicts the machine-made millennium.

"'The discovery of a radio-motor,' says Mr. Maxim, 'will make power so cheap that none will work save for recreation; crystallization of fertilizer out of the atmosphere will make the earth so prolific that farming will be a pastime; disinfectant solutions forced through the body will exterminate all germs, and disease will be eliminated; life insurance companies will become simply accident insurance companies, and man's life will run its allotted span; criminals will no longer be imprisoned, but will be segregated in a great reservation where they will live out their lives, the right to propagate their kind denied them, thus eventually cleansing the world of its criminal element; the mastery of the air will liberate mankind from the limitations of navigable rivers and railroad tracts; gold will be so common that it will be used for rifle bullets; diamonds as big as the Kohinoor will be made for a dollar, and the city of the future will not be a collection of buildings, but one vast arcaded building with its subdivisions carefully allotted for the needs of its inhabitants.'"

Value of the Brick Arch.

No attachment to the locomotive engine has been the subject of so much conflicting opinion as the value of the brick arch. When it was first applied to the firebox of a locomotive, the engineering world was laboring on the problem of how to burn bituminous coal without creating so much smoke that health authorities would forbid the use of that kind of fuel. Wood that had previously been used on the American continent, was exempt from objections because to stop its use was to stop operating of the railroads, which the people were not prepared to stand for. The smoke from wood was bad enough, but the smoke from soft coal was worse, unless some means was provided to improve its combustion, to the extent of preventing the emission of black smoke. Hundreds of inventions were produced that aimed at smoke prevention, but none of them survived the tests of protracted service except the brick arch.

The brick arch was invented almost simultaneously by George S. Griggs, of the Boston & Providence Railroad, Boston, and Thomas Yarrow, of the Scottish North Eastern Railway, Arbroaten. Griggs's invention was adopted in America and that of Yarrow, in Europe. Before the introduction of soft coal, European locomotives burned coke which was very costly, but was perfectly smokless. The use of coal brought out very strict regulations for the punishment of those who created a smoke nuisance and very painstaking efforts were made to find out means that would absolutely prevent the creation of smoke. None of the ingenious combinations of furnace apparatus for smoke prevention worked satisfactorily without the brick arch. There were baffle plates and air bars, there were air tubes, hollow stay bolts and air injectors, but the whole of them needed the brick arch as an indispensable auxiliary. After longer or shorter experience most railway companies discovered that the brick arch would do the business fairly well without any aid and all its assistants were by degrees dispensed with.

The locomotives hauling trains in Europe can hardly be called smokeless, but charity covers their sins in this respect, for very few prosecutions are recorded, yet all their smoke preventing appliances consist of only the brick arch. That is a case of falling from grace for a little care devoted to introducing air above the fire would clear the atmosphere very materially. But railway companies the world over trouble themselves little about creating nuisances so long as law's majestic force leaves them alone.

In most American States the railroad companies tried to restrain the creating of smoke when permission to burn bituminous coal was first granted, but their zeal in this respect was short lived. The brick arch was something extra to care for which condemned it from the first, and it gradually fell out of use. Some railroad officials had investigated the merits and short-comings of the brick arch sufficiently to learn that it was a fuel saver and that its use increased the capacity of the boiler. Such people maintained that the brick arch was a paying investment, although it needed care and attention, so it did not suffer absolute banishment from American railroad locomotives. Of late the brick arch has been beginning to find favor on some of our railroads and is reported to be giving high satisfaction as a fuel saver where it receives a fair opportunity to show its capabilities. Those interested in running locomotives on the smallest quantity of fuel consistent with fair steam generation, ought to study the paper on "The Brick Arch," and the discussion thereon that will appear in another issue.

Railways Operated by Governments.

Street railroads and other public utilities have always been badly managed when operated by municipal authorities in this country, but certain politicians among us are always howling against railroads and similar property being managed by their owners.

Several experiments have been made in the United States of railroads being managed by state officials and the results have always been deplorable. An employee of a railroad company considers it no hardship being required to perform duties properly in return for the pay he receives; a political hireling on the other hand considers that the pull he has with his party ought to bear a portion of the burden of daily duties. When a complete force of railroad men operates under such sentiments incompetency follows and the combined labor of political railroaders produces the most inferior kind of performance. Responsibility for the proper performances of their duties reaches political railroad employees through a buffer that excuses neglect with the result that the duties are less faithfully performed than they are on railroads operated by companies.

The two countries in Europe that have controlled railways most thoroughly are Belgium and Switzerland. A dispatch to the New York *Sun* from Brussels says:

In Belgium, as in Switzerland, the exploitation of railroads by the state is proving rather a disastrous experiment. The deficit on last year's working was estimated between $800,000 and $1,000,000, but it now appears that it will exceed $2,000,000. The situation is so bad that the administration, which had already decided on raising the price of the fortnightly and monthly passes so well known to tourists, is now considering the question of a big all-around increase in passenger and freight rates.

The press dispatch from Berne, Switzerland, reads: The unfavorable results of the State ownership of railroads in Switzerland promises to be a leading issue in the coming electoral campaign. The confederation has $240,000,000 invested in railways, having issued that amount of interest bearing bonds. Although the receipts of the State operated roads have steadily increased from 1902 to 1907, the cost of operation has increased more rapidly still, and the co-efficient of railroad operating expenses is now the largest in Europe. The deficit this year will be between $1,000,000 and $1,200,000. The nationalization of the roads, therefore, this year costs the taxpayers the deficit for operation in addition to the interest on the state capital invested.

The Men Who Do the Work.

We have several times had occasion to refer with satisfaction to the growing idea of the supreme importance of safety in railroad operation in this country. The realization of this is no doubt due partly to an enlightened public opinion, and to the more serious view taken by railroad officials of what proper discipline really means, but it is also largely due to the grasp of the whole situation by the employee on the road. It is his conception of duty. All these work together for good.

This last mentioned factor is probably the most important of the three. As we said in our October issue, the spirit of "amenability to supervision" on the part of those who do the work shows a healthy condition. It means that when a new safety appliance or a new regulation comes out on a road, that the men give it a fair trial and they make it work well if it is capable of being worked well. In one of Rudyard Kipling's poems he has this meed of praise for those much-needed men in the world who honestly perform their allotted tasks:

"Creation's cry goes up on high from age to cheated age:
"'Send us the men who do the work for which they draw the wage.'"

One of the signs of the times to which we have alluded before now is the splendid response given by the engineers on many of our leading roads to what has been somewhat incorrectly called the surprise system of checking in signal observance. In another column of this issue will be found an account of a new system of train dispatching on the Northern Pacific. It is described by the superintendent of the division where it is in vogue. He speaks of the good points of the system, but he pays a warm tribute to the faithful service and honest endeavor of the men working under the system, and he admits that the success achieved is due to the men.

This is as it should be. There is no greater guarantee to the public of safe railroad operation than the willing and intelligent obedience of the men who do the work. It is the manly, square, playing of the game according to the rules that is really worth while. Illegitimate short cuts to the goal and grand stand plays may be very spectacular, but they are false in principle and cannot for a moment compare with the clear-headed team work that pushes on steadily and wins.

The strength of the lines quoted above lie in the reality of the words: "do the work." There is in them no account taken of the men who intended to, or hoped they did, and we believe there is now on all our railways a steady advance of the idea of team play pervading all ranks of the service. The officers may be able men, and the rules good, but the men are the ones with whom lies victory or defeat. Instruction of employees is a most important matter and has been ably carried out by many of our leading roads, and hand in hand with this should go the really competent and constant supervision of daily work. To quote Kipling again, and to quite fairly apply his words concerning the army of war, to the industrial army of peace on our railroads, "the backbone of the army is the non-commissioned man."

Book Notices

American Machinist's Handbook and Dictionary of Shop Terms, by F. H. Colvin and F. A. Stanley. Hill Publishing Co., New York. Flexible leather. 4 x 7 ins. 520 pages, gilt-edged. Price, $3.00.

This will be found a very useful book to all engaged in the various branches of machine work. The information requisite in shop practice is condensed and classified in a form that is immediately available, and the book is a perfect library in itself and of such convenient form as may readily be carried in the pocket. The presswork is of the usual high character of the Hill publications. The work is profusely illustrated, and the drawings have a distinct clearness, not common in many mechanical works. A carefully prepared index adds much to the utility of the work.

The Electrical Pocket Book for 1909. Emmott & Co., Manchester, England. This is one of the year books issued by the publishers of the *Mechanical World*, and presents in a condensed form much practical information, in regard to the use of electricity. A new and interesting feature of the new edition, is a chapter on electric welding which should interest all who are desirous of simplifying this important branch of mechanics. The price of the book, twenty-five cents, should insure much popularity.

Graphical Determination of Earth Slopes, Retaining Walls and Dams, by Charles Prelini, C.E. Published by D. Van Nostrand Co., New York. 140 pages. 6 x 9 ins. Ornamental cloth. Price, $2.00.

Prof. Prelini, who has been engaged for many years as an instructor in civil engineering, in Manhattan College, New York, has made a valuable contribution to engineering literature in the work before us. Young engineers will find it profitable to study this book. It takes high rank in the important subjects of which it treats. The forces which determine the various slopes of the earth's embankments, the pressure of the earth against a retaining wall, the proper designing of retained walls, and other subjects equally interesting are treated in the best possible manner calculated to engage the minds of young students. The book will also be of real help to the practical engineer.

The Application of Highly Superheated Steam to Locomotives. By Robert Garbe. Published by the Norman W. Henley Publishing Company, New York, 1908. Price, $2.50.

This book is a reprint from a series of articles which have appeared in the columns of *The Engineer*, of London, and are from the pen of Robert Garbe, a German engineer. The book, however, is edited by Mr. Leslie S. Robinson, secretary to the (English) Engineering Standards Committee, who is himself the author of several important works on boilers. The book is neatly bound in cloth and has 70 pages, 9½ by 6 ins. It is illustrated with a number of good, clean line cuts and has a number of tables and diagrams. It is divided into eight chapters, dealing with the Generation of Highly Superheated Steam properties and advantages and production of such steam in locomotive boilers; Superheated Steam and the Two-Cylindered Simple Engine losses by condensation, economies in fuel and water, tractive effort of the superheated steam locomotive; Compounding and Superheating; Designs of Locomotive Superheaters smoke tube superheaters, boiler-barrel superheaters, waste gas superheaters; Constructive Details of Locomotives Using Highly Superheated Steam—cylinder and pistons, piston-rod stuffing boxes, piston valves, double admission, and solid rings, piston-valve with balanced split-rings and valve covers acted on by steam, pressure equalizing arrangement, lubrication, special fittings for locomotives, special working regulations, superheated engines on the Prussian State lines; Experimental and working results, etc.

Amende Honorable

It is always dangerous to get mad, especially when it leads to saying nasty things about good people. A free confession is good for the soul, and the writer wishes to confess that he was woefully unjust to the Entertainment Committee of the Master Mechanics' Convention when he applied offensive epithets to them in our July number. On considering the matter calmly the writer of the offending article confesses that an apology is due to the committee, consisting of:

Charles P. Storrs, Storrs Mica Co.
Herbert Self, Crandall Packing Co.
E. H. Walker, Standard Coupler Co.
J. W. Johnson, Pyle National Elec. H'd L't Co.
S. W. Midgely, Curtain Supply Co.
Bertram Berry, Haywood Bros.
C. S. Hawley, Cons'd't'd Car Heat'g Co.
F. O. Brazier, Murphy Varnish Co.
Ross F. Hayes, Curtain Supply Co.
C. M. Garrett, Farlow Draft Gear Co.
W. J. Walsh, Galena-Signal Oil Co.
A. G. Langston, Jenkins Bros.
J. L. Connors, Ralston Steel Car Co.
G. H. Forsythe, Forsythe Bros. Co.
H. E. Oesterreich, Wendell & MacDuffie.
J. L. Stayman, Gold Car Heating and Lighting Co.
P. J. Mitchell, P. J. Justice & Co.
L. J. Hibbard, American Brake Shoe & Foundry Co.
J. S. Seabury, Mass. Mohair Plush Co.
T. C. DeRosset, T. H. Symington Co.
E. P. Welles, C. H. Besley & Co.
J. C. Younglove, H. W. Johns-Mandville Co.
R. H. Chisolm, Railroad Age-Gazette.
Clayton W. Old, Am. Blower Co.

Applied Science Department

Elements of Physical Science.

Second Series.

III. Transferring Heat.

There are three methods of conveying heat from one body to another. The most common method is by radiation, as in the case of burning wood, coal or oil in a furnace the heat is transferred to the sheets on the sides and crown of the fire box by radiation. The passing of the heat through the sheets is by conduction, while the water in the boiler is heated by convection.

The velocity with which heat is transferred from one body to another is in a great measure proportionate to the difference in the temperature of the bodies. The greater the difference in temperature the more rapid will be the flow of heat from the one to the other. It will be readily noted that some bodies conduct heat much more rapidly than others. The conducting qualities of metals are extremely variable as for instance in the case of silver and iron the former may be rated at 100, while the latter would scarcely equal 12. In a similar ratio copper would equal about 75, brass 23, and lead 8. Metals which conduct heat readily and rapidly are said to be good conductors, while those that are otherwise are said to be bad conductors. Gases and liquids are very bad conductors and they cannot be heated at all by conduction. At the same time they are both easily and readily heated by convection.

As an example of heating by convection, or carrying, it may be noted that the flues in a boiler are used so as to overcome the non-conductive quality of water. A common illustration is the filling of a test tube with cold water and allowing a flame of a candle to come in contact with the upper surface of the water. The water may be made to boil at its upper surface while the water in the bottom of the tube has not appreciably changed in temperature. When the heat is applied to the bottom of the vessel containing the water the expansion of the liquid molecules of water near the hot place causes them to rise to the upper surface, and thus a circulation of the liquid particles is created, the heavier particles naturally tending towards the bottom of the receptacle. A free and easy circulation is an essential feature in steam boilers, and the best boilers are those that are so constructed that a uniform temperature can be most readily maintained, thereby preventing unequal expansion of the boiler plates, and rendering the escape of steam to the upper surface natural and easy.

Heat has the effect of expanding all bodies. This is particularly the case in the application of heat to metals. The amount of expansion varies, of course, with the degrees of heat applied to the metals, but in the case of boiler plates or flues raised to a uniform heat of over 300 degrees, which occurs when the steam is at a pressure of 100 lbs. per square inch, the expansion is equal to nearly one five-hundredth part. Thus a boiler 21 feet in length would expand ½ inch. For this reason it will be noted that locomotive boilers are not rigidly attached to the frames but are slidably engaged by expansion pads or suspending links or other devices. The frames are not heated to any appreciable extent, and hence have little or no expansion. For the same reason expansion joints are necessarily used in pipes that convey steam any considerable distance and are easily constructed in the form of a sleeve with adjustable packing box. We remember seeing an expansion loop in a pipe which was used in a round house. The loop carried the pipe over the doorway and was artistic and useful at the same time.

The application of heat to air or gases has the effect of expanding the volume of gas or air very rapidly and very largely in comparison with other bodies. As the atmosphere is a fluid more than eight hundred times thinner than water, so the application of heat passes through the volume of air easily and rapidly. The degrees of expansion have been carefully calculated and the ratio of action of air or gases when heated is known as the law of Charles, and may be briefly explained by the following illustrations:

A quantity of air amounting to 10 cubic feet at 60 degrees of heat will, if heated to 250 degrees, occupy a space of 13.65 feet. From this experiment the following calculation is readily based. To the degrees of heat add 461, and by Charles' law, the absolute temperature, upon which many calculations are based, is found, thus:

$60+461=521$ absolute temperature.
$250+461=711$ absolute temperature.

Then it follows that as the volume of a gas under constant pressure, or the pressure of a gas at constant volume, varies as the absolute temperature, therefore the increase in volume in the calculation before us will be as 521 representing 10 feet at 60 degrees is to 721 at 250 degrees, or 13.65 feet.

The pressure of heated air may be readily found by the same rule, thus, if a volume of air at 212 degrees be confined in a rigid vessel and exerts a pressure of 15 lbs. on each square inch, what will be the pressure if the air is heated to 300 degrees, the space occupied by the air remaining the same?

$212+461=673$ absolute.
$300+461=761$ absolute.

The amount of increase of pressure will therefore be as 673 is to 761, or as 15 lbs. is to 16.96 lbs.

Celebrated Steam Engineers

XIV. John and Robert Stevens.

This remarkable family is an illustration of the occasional instances where the inventive faculty seems to descend from father to son. John Stevens, the elder, learned law and civil engineering in New York city, where he was born in 1749. He became prominent in the political affairs of New Jersey and at the outbreak of the Revolution he became a Colonel in the Continental army and saw much active service under Washington. He was president of the convention of New Jersey delegates who ratified the Constitution of the United States and continued during his lifetime to be a leading national character. He was among the first to give attention to steam navigation, and while others were working with paddle wheels Stevens perfected a vessel working with screws, almost similar to what are now in use. The question of priority in steam navigation would be as difficult to settle as the question of priority in aerial navigation in our own day. It was the work of many master minds, and while Fulton was undoubtedly the first to make an enduring success in this department of steam propulsion, it is a noteworthy fact that in the year which saw the triumph of Fulton's *Clermont* also saw the launching of Stevens' *Phoenix*. Fulton had secured from the legislature the right of steam navigation on the Hudson. Stevens, not to be outdone, took his steamboat out to sea and reached the Delaware River, where his steamer plied successfully for many years. It may be added that while Fulton obtained a

kind of victory over Stevens in point of priority, the wealth and influence of Stevens was more than a match for the less fortunate Fulton.

The first regular ferry from New York to Hoboken was established by the Stevenses, father and son together, in 1811, and was a connecting link in their stage line to Philadelphia. In 1812 they planned a revolving steam battery, to be plated with heavy sheets of iron and embodying the principle afterwards successfully used by Ericsson on the *Monitor*. At this time father and son turned their attention to railroading. They urged the construction of a railway from Albany to Lake Erie. They furnished complete plans for the Camden and Amboy Railroad and although the road was not immediately proceeded with, the same plans were afterwards successfully used in establishing the South Carolina Railroad. In 1815 they secured a charter for a railroad to be constructed between the Raritan and Delaware Rivers, and although its construction was long delayed, it was the origin of the first link that became the Pennsylvania Railroad. Their experiments with locomotives were carried on for many years, and one of their construction was running as late as 1826.

Robert Stevens, the younger, was the first to use anthracite coal in furnaces. At the building of the Camden and Amboy Railroad, which had been long delayed, he introduced the T-rail in the same form which it has still retained. The ferry boats peculiar to American rivers and harbors, with shallow draught and overhanging sides, are of his designing. He perfected many improvements in boiler construction whereby the steam pressure was safely raised to 60 lbs. per square inch. It may be added that in introducing locomotives on American railways he was the first to equip them with a pilot or cow-catcher. His work as a railroad and steamboat promoter was eminently successful and the wealth and influence of the father grew and blossomed in the hands of the son.

The Stevens Institute in Hoboken, New Jersey, was instituted by him. It is universally recognized as one of the leading engineering schools in the world. It prepares young men for employment on railways and other works where machinery is designed and operated. The students number nearly 300, and on graduation receive the degree of mechanical engineer.

Our "Book of Books" is a convenient reference for people interested in the purchase of mechanical engineering and other scientific books. It is sent free when asked for, and free gifts are not very numerous these days.

Questions Answered

LEAKAGE OF TRIPLE CHECK VALVES.

72. W. W. P., Newark, Ohio, asks what per cent., or rate, do quick-action triple check valves leak?—A. This question cannot be answered explicitly. If you put the question under the form, are quick-action triple valve checks often found defective? we would say: Quite frequently they are, on coal, coke and ore cars, but very few are found in leaky condition on merchandise, ordinary box or passenger cars. In some localities, cleaning the triple valve consists principally of wiping off, and oiling the piston and slide valve, while the triple valve is on the car, and where this practice is in vogue it is often difficult to find a triple valve with a check valve that does not leak.

TRAIN LINE LEAK AND TRAIN CONTROL.

73. W. W. P., Newark, Ohio, asks under what conditions would you consider that a leak in the train line would cause loss of control of a train of cars? —A. The conditions would be that if you were descending a grade and if the volume of air required to properly operate the brakes, plus the train line leakage, were together in excess of the capacity of the pump, there would be loss of train control after a short time.

DEFECTS OF MAKE-UP AND EQUIPMENT.

74. W. W. P., Newark, Ohio, writes: Please state the defects of brake, the handling, and the make-up of trains that would cause the pulling out of draw bars.—A. Space will not permit of a complete answer to this request. Read the article on "Handling Trains," published in the Air Brake Department of RAILWAY AND LOCOMOTIVE ENGINEERING for October, page 441, and also read the article on "Undesired Quick Action," in the November issue page 488.

CYLINDER PACKING.

75. J. M. C., Sayre, Pa., writes: For the last month we are having a great many failures on account of cylinder packing blowing. Have placed cylinder packing in engines and it would blow or wear out in less than 100 miles. It is only lately we are having this trouble. Piston heads are about 1/16 in. smaller than cylinder. Can you give me a remedy for same? Cylinders are 22 by 30 ins.; packing ring is ⅞ in. wide, 11/16 in. thick, 5/16 in. larger than cylinder.—A. We presume the piston packing rings are the rings referred to. If the trouble has only occurred during so short a time as one month it may be on account of a change in the kind of metal used, as for instance, very soft pig iron being used instead of a harder kind, which would retain its elasticity for a longer time. We would suggest that the rings are too deep in section at 11/16 in. for so wide a ring as ⅞ in., and that 9/16 in. deep would give better satisfaction if turned 9/16 in. larger than the diameter of the cylinder for so large a cylinder as 22 in., or even possibly a little more, depending upon the hardness of the metal. The friction on the cylinder would be less and the range of spring of the ring would be greater. Rings having only 5/16 in. spring are too rigid for good service.

SLIP OF MALLET COMPOUND

76. Subscriber asks: Why does a mallet compound engine slip so easy on high-pressure engine? It seems to be a little slip every time engine passes the quarter on high pressure, engine mostly, and it seems to me it is impracticable to run an engine on sand sixty miles, which is one-half of the division, and the other half the wind is blowing so that no sand device can put any sand on the rail. Please advise if there is any way to keep the high pressure on a mallet compound from getting quarter slipped?—A. We would see no reason why the high-pressure part of the engine should slip more readily than the low pressure, as the valve and cylinder sizes are so proportioned as to give equal work to both engines and the weights on drivers of both ends of the engine are practically the same. At speeds below 100 revolutions the low pressure develops a slightly greater tractive power than the high pressure, but at higher speeds reverse is true. A mallet compound engine generally gives much less trouble from slipping than any other type of engine. If the high-pressure end of the engine starts to slip, the excess steam accumulates in the receiver, creating so much back pressure that slipping is automatically stopped. If, on the other hand, the low pressure starts to slip the steam is exhausted from the receiver, again automatically preventing the continuation of the slipping.

The third annual report of the National First Aid Association of America is before us, and it is particularly gratifying to learn from its pages that in spite of the general financial depression through which our country has passed during the year there has been a steady growth of the good work of this noble association. Since the organization of this association three years ago, 3,428 students have been registered and 1,538 diplomas have been issued. Among the railroad divisions of the association the branch in connection with the employees of the Boston & Maine Railroad has made rapid progress during the year. There are eight classes in this division, with a membership of 168.

Air Brake Department

Brake Shoe Friction.

By G. W. Kiehm.

As a brake shoe is drawn against the wheel of a car in motion, it exerts a force to prevent the wheel from revolving, the weight of the car causes the wheel to revolve and the work the brake shoe must do in order to gradually destroy the energy stored in the wheel is determined by the speed of the wheel and the weight holding it to the rail.

The entire air-brake equipment of the locomotive is designed for the purpose of pressing the brake shoe against the wheel with a predetermined force, for a certain length of time and at any time desired.

It is not essential that the operator of the brake should have a thorough knowledge of the forces tending to retard the motion of the wheel, and those compelling the wheel to rotate, but a general knowledge of those forces is of practical value.

A variety of terms are used to express, in an intelligible manner, the results of forcing a brake shoe against a revolving wheel, and friction is the resistance to motion between two bodies in contact due to the interlocking of projections on the surface of each, which interrupt or oppose each other and must be broken off, bent or crushed, before the rubbing surfaces can pass each other.

The result of this friction is wear of one or both of the surfaces in contact, and the generation of heat, and it may be said that the force represented by the wheel in motion is transformed into heat.

The heat is dissipated by being forced through the brake shoe into the atmosphere, by being absorbed by the wheel, and in heated particles of metal being thrown off the shoe and burned in contact with the atmosphere, the shorter the space of time in which the rotation of the wheel is checked the higher the degree of heat generated. The retarding effect of the shoe against the wheel is expressed in terms of "the co-efficient of friction" and the co-efficient of friction is a proportion which exists between friction and pressure, it is a figure obtained by dividing the actual pull of the brake shoe tending to stop the wheel by the load pressing the shoe against the wheel, or the co-efficient of friction being known, its per cent. of the force applying the shoe is the retarding effect of the shoe in pounds, therefore, the co-efficient of brake shoe friction is a percentage of the pressure forcing the shoe against the wheel.

The figures used in calculations are in decimals, but for convenience they are expressed in per cent. and the actual pull of the shoe on the wheel has been determined by carefully conducted tests, and from the tests it has been discovered that the co-efficient of friction of the brake shoe decreases with an increase of pressure, decreases with an increase of speed, and at a constant speed decreases with an increase of time of application, but the co-efficient of friction increases as the velocity of the wheel diminishes and rises very rapidly just before the wheel stops, and this is why the extreme braking power developed by the use of the later types of triple valves is permissible while the speed is high and must be reduced, to prevent wheel sliding, as the velocity of the wheel diminishes.

AMONG THE THOUSAND ISLANDS. GRAND TRUNK RAILWAY.

So long as the pull of the brake shoe against the wheel does not exceed the adhesion of the wheel to the rail, the wheel will continue to revolve and the adhesion of the wheel to the rail is constant at all speeds, but the co-efficient of adhesion, which is a percentage of the weight on the wheel, varies with the condition of the rail.

The retarding force of the brake shoe is limited to the adhesion or resistance obtained between the wheel and the rail and the gratest effect is produced when the brake shoe friction amounts to a quantity just short of the adhesion, and as soon as the friction exceeds the adhesion, the wheel will lock and slide.

When the rotation of the wheel has been arrested by the pressure of the brake shoes, the retardation then arises from the friction between the wheel and the rail, which is measured by the force exerted to hold the wheel in its fixed position, or by the force required to draw the wheel along the rail. The difference in the force required to draw the wheel when locked and when revolving freely is the measure of retardation.

The friction between the wheel and the rail, when the wheel is sliding on the rail is in some cases about one-third less than the friction produced between the brake shoe and the wheel, and the pressure required to slide the wheel is much higher than that required to hold them sliding.

At a constant speed, the difference in draw-bar pull when the wheels are revolving freely and when the shoes are drawn against the wheel, represents the brake shoe friction.

As the speed of the braked wheel decreases the co-efficient of friction rises rapidly, closely approaching the value

of state friction. Authorities on the subject state that the static friction of steel on cast iron at a pressure of 180 lbs. per sq. in. is 30%, and at 336 lbs. per sq. in. it is .347. When the rotation of the wheel has been arrested and the wheel is sliding on the rail, the static friction between the wheel and the rail is changed to dynamic friction and the co-efficient of this dynamic friction between a steel tire and a steel rail when just coming to rest, is approximately 25%, at 14 miles per hour .072, and at 55 miles per hour .038.

Experiments have proved that the co-efficient of adhesion of the wheel to the rail, previously referred to as a percentage of the weight on the wheel and constant at all speeds, is on a dry rail usually over 20%, on wet and greasy rails it frequently falls below .18, but with the use of sand on wet rails it is at all times over .20, and when sand is applied to the rail in such a manner that the wind from the rotating wheel does not blow it from the rail, the adhesion is as high as .35 or .40.

When the co-efficient of adhesion equals .30 of the weight on the wheel a pressure equal to 1.20 of the weight would be required to slide the wheel at a speed of 75 miles per hour; at a speed of 40 miles per hour a pressure equal to 2.07 of the weight would be required, and at 60 miles per hour a shoe pressure equal to 4.14 times the weight on the wheel would be required to slide the wheel.

If, however, the adhesion is only 0.15, the pressure required to slide the wheel would be but 0.60 at 7.5 miles per hour, 1.04 at 40 miles per hour, and 2.08 at 60 miles per hour; thus the efficiency of the brake depends upon the pressure being proportioned to the speed and to the adhesion.

The co-efficient of friction varies according to the material and the weather, but varies principally with the speed of the wheel and the time of application.

Some tests show that the co-efficient of friction of a cast-iron brake shoe acting under a load of 3,000 pounds at 30 miles per hour is .28, whereas the same shoe applied with a load of 6,000 pounds against the wheel at 30 miles per hour is .23.

The test which shows that the co-efficient of friction of a cast iron shoe, applied with a force of 3,000 lbs. to a wheel revolving at the rate of 30 miles per hour is .28, shows that the same shoe acting under the same pressure at 54 miles per hour is only .20.

Those figures taken from shop tests are merely given as an example, other figures obtained from a train in motion show that the co-efficient of brake shoe friction, during stops from a speed of 60 miles per hour, is sometimes as low as .058, and as the train is stopped sometimes reaches .34. An average taken from hundreds of experiments shows that at 60 miles per hour the co-efficient of friction is .074 at 40 miles .140, at 20 miles .192, and 10 miles .242, and as the wheel is coming to rest .330.

At a constant speed the co-efficient of friction diminishes with the increase in the time of application, during a series of tests, at a speed of 60 miles per hour, at the commencement of the experiment a co-efficient of friction of .072 was observed, and ten seconds afterwards, with the speed and pressure constant, .058.

At 20 miles per hour the co-efficient of friction at the beginning of the experiment was .182, ten seconds afterward .133, and 20 seconds afterward .099.

In order to more fully appreciate not only the advantage but the necessity for the later Westinghouse Air Brake equipments, let us suppose that we have a car weighing 40,000 lbs., resting on two four-wheeled trucks and braked at 90% of its light weight, which will have a weight of 5,000 lbs. on each wheel and a pressure of 4,500 lbs. on each brake shoe when the brake cylinder pressure is 60 lbs. per square inch.

If the co-efficient of adhesion is 20%, 5,000 x .20 or 1,000 lbs. is the force that must be overcome by the co-efficient of brake shoe or kinetic friction before the wheel will cease to revolve when the speed is low; this may be termed the co-efficient of static friction, for no matter how rapidly the wheel revolves, a portion of it is always at rest in contact with the rail. At 60 miles per hour 4,500 x .074 or 333 lbs. is the force in pounds tending to arrest the rotation of the wheel, while the force required to arrest the wheel at 60 miles per hour is 1,000 x 2.77 or 2,770 lbs., which tends to show how inefficient the ordinary quick action brake is and how impossible wheel-sliding is at this speed.

At 40 miles per hour the co-efficient of friction is 4,500 x .14 or 630 lbs., the force required to slide the wheel is 1,000 x 1.38 or 1,380 lbs.

At 7.5 miles per hour the co-efficient of friction is 4,500 x 25 or 1,125 lbs., and the force required to slide the wheel is but 1,000 x 0.83 or 830 lbs., which shows that an inefficient brake at high speeds will flatten wheels at low speeds if the brake is held applied when a steep grade or an unbraked weight keeps the train in motion. If the co-efficient of adhesion is but 15% the pressure required to slide the wheel at 60 miles per hour is 5,000 x .15 = 750. 750 x 2.08 = 1,560 lbs.

At 40 miles per hour the co-efficient of friction is 630 and the co-efficient of static friction is 750 x 1.04, or 780 lbs., closely approaching wheel sliding at 40 miles per hour due to the low co-efficient of adhesion.

If the co-efficient of adhesion, due to the use of sand, is 30% the force tending to keep the wheel revolving is 5,000 x .30 x 1.20 or 1,800 lbs., while the co-efficient of brake shoe friction is 4,500 x .25 or 1,125 lbs.

The use of the type L triple valve develops a brake cylinder pressure of approximately 100 lbs. from a brake pipe pressure of 110 lbs., and on this car the braking power would be increased from 90% of its weight to 125% by the increase of brake pipe pressure and to 150% by the use of the type L triple valve which would give a pressure of 7,500 lbs. on each brake shoe when the brake is used in the emergency.

This is on the assumption that the L triple is being used without using a pressure reducing valve on the brake cylinder. In railway practice, during the transition period, while the L N equipment is coming into use and where the L triple valve is used, as it certainly will be, with ordinary quick action triple valves, a pressure reducing valve is necessary on the brake cylinders in conjunction with the L. triple valve when high brake pipe pressures are used.

The L N equipment includes the L triple valve, a supplementary reservoir, a safety valve, and a cut-out cock. When used with the P triple valve, the cut-out cock between the L triple valve and the supplementary reservoir is closed so as to shut off the supplementary reservoir, and the pressure reducing valve on the brake cylinder blows down the high brake cylinder pressure, so as not to cause wheel skidding. In fact, where the old and new equipments are used constantly in the same train, the supplementary reservoir, the cut-out cock and the safety valve on the triple may be dispensed with, while using 70 lbs. brake pipe pressure.

For high speed work, with 110 lbs. brake pipe pressure this arrangement will answer, but it must then have the pressure reducing valve on the brake cylinder. One of the claims made by the Westinghouse Air Brake Company for the type L triple valve is that it is possible to use the L triple in high speed service with a brake pipe pressure of 90 lbs., and actually get better results with it than with the older equipment using 110 lbs. brake pipe pressure.

Electrical Department

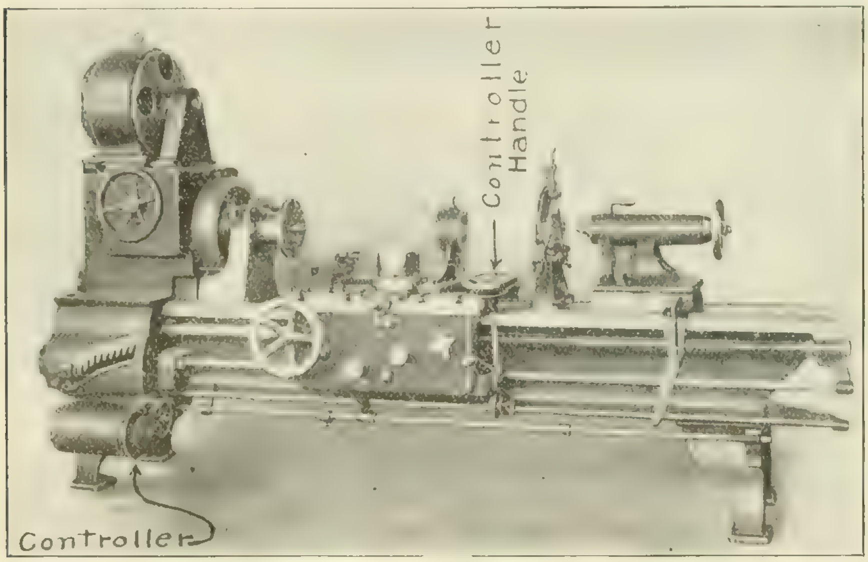
Individual Motor Drive.

By W. B. Komvenhoven.

Machine tools as are found in railway repair shops, require a considerable range of speed variation with small intermediate steps, and also that for any given step the speed should remain practically constant from no load to full load.

Formerly it was customary to use one or two large engines of several hundred horse-power each, driving a string of line shafting to which the lathes, planers, boring mills, and other machine tools were connected by means of belts and countershafts. The speed variation was obtained by shifting the belts from one step to the next on a cone pulley, and by means of back gears. This gave a speed variation which was in reality a series of large jumps, usually increasing the speed in steps of about fifty per cent. each. It is more than likely that the best and most economical cutting speed for the work will fail to exactly correspond to one of these steps, but will fall between two successive steps.

The principal advantages to be gained by the use of individual drives are, first, the elimination of the losses in the line shafting and this amounts to 30 per cent. or more of the output of the engine; second, it is possible to locate the power plant for the motors at any convenient point; third, the intermediate speed changes may be made as small as desirable and tools may be operated at the cutting speed that will give the highest efficiency; fourth, overhead crane service may be installed because of the absence of the belting and shafting, and thus greatly facilitate the handling of heavy pieces of work; fifth, economy is not only gained by the elimination of shaft losses but by the possibilities of flexible operation when it is desired to run only a few machines; sixth, the ease with which the plant may be extended; seventh, increased economy of floor space makes it possible to install the machine tools to advantage; eighth, the simplicity of the control and ease of its manipulation makes possible to use not only the proper speed for the cutting tool, but saves the time formerly spent in shifting belts; ninth, the illumination and cleanliness of the shop is vastly improved; and tenth, the construction of the building is simplified owing to the absence of overhead shafting.



HANDLE OF CONTROLLER CONVENIENTLY PLACED.

MOTORS.

There are two general types of direct current motors that are available for driving machine tools, the series motor and the shunt motor. The series motor was described on page 547 of the Dec. 1907 issue, and its action was compared to a compound steam locomotive.

The shunt motor has four terminals, two field and two armature. Both field terminals and both armature terminals are connected to the supply mains. This style of connection is known to electricians as a parallel or shunt connection. The shunt motor field is often called simply the shunt field, and is made with a high resistance, because it is connected directly to the mains. Parallel or shunt connections may be compared to the cylinders of a simple locomotive. The same steam does not pass through each cylinder. So in a shunt motor the same current does not first pass through the field and then the armature, but the field has its own separate current and the armature its individual current.

The series motor, while it does excellent service in driving trolleys, motor cars, and other similar devices, is unsuitable for driving machine tools. Its principal disadvantage is the difficulty to maintain the speed constant with a varying load. When a cut on a lathe or planer comes to an end the motor will race; as explained on page 209 of the May issue. The shunt motor on the other hand, when connected across the supply mains, will rotate at a certain fixed speed. This speed is called by electricians the normal speed of the motor, and is practically constant from no load to full load. The speed of a shunt motor depends upon two conditions, the voltage supplied to its armature terminals, and the strength of its field magnetism. If the terminal voltage is increased the motor will naturally increase its speed, in much the same manner that a steam engine increases its speed with steam at an increased pressure. If the strength of its field current is decreased, thus reducing its field magnetism, the speed will also increase.

This is due to the effort of motor to maintain its counter electromotive force, constant. The meaning of the term counter electromotive force or back voltage, was explained on page 209 of the May issue. The value of the counter electromotive force depends upon the strength of the field magnetism, and upon the number of revolutions per minute of the armature. The strength of the field magnetism varies with the value of the field current. Therefore, when the strength of the field current is decreased, the field magnetism is decreased, and the motor must increase its speed in an effort to maintain the counter voltage constant.

The method of varying the field current is to introduce a variable resistance into the field circuit, known as a field rheostat. The weakening of the shunt field magnetism not only increases the motor's speed, but permits the magnetism produced in the armature by the current flowing there to shift or distort the field magnetism. Now, the armature magnetism opposes that of the field. When the field current is full on, the field magnetism produced is very strong compared to that of the armature, and it may be considered to be shoved or squirted into the surface of the armature that lies directly

under the field pole. But when the field current is weakened, the field magnetism is also weakened, while that of the armature remains the same. This weakened field is shifted somewhat to one side by the armature magnetism, and no longer lies directly under the field pole. The amount of distortion depends upon the difference between the shunt field magnetism and that of the armature. This armature magnetism is usually called by electricians the back ampere turns of the armature.

The shifting of the shunt field becomes so great when the field has been weakened enough to increase the speed of the motor more than 100 per cent. above normal, that sparking at the brushes is the result. This sparking is injurious to the motor and reduces the available speed range of the ordinary shunt motor to 1 to 2. The intermediate steps or changes in speed may be made as small as is desired, by simply increasing the number of contact points of the field rheostat.

MULTI-VOLTAGE SPEED CONTROL.

We will consider only the multi-voltage and interpolar motor systems of variable speed control.

The multi-voltage system is based upon the combination of the two methods for varying the speed of a shunt motor, namely, varying the voltage of the supply and the field current. The combination of the two produces a wide speed range without sacrificing the smaller increments in speed. The Crocker-Wheeler system of multi-voltage control is one of the successful ones in use at present. It is employed in the Collingwood repair shops of the Lake Shore Railroad, located near Cleveland, Ohio. This system employs three generators connected together by means of couplings to form one unit, the first generates 40 volts, the second 80 and the third 120. These three voltages are combined through various connections to form six different combinations of the following voltages, 40, 80, 120, 160, 200 and 240 volts.

The motor is started on 40 volts and here gives its normal and at the same time lowest speed. The normal speed of the motor at 40 volts is increased step by step, by means of the field rheostat, which reduces the field current until the speed has increased almost 100 per cent. Then the motor connections are transferred to the 80 volt supply and the speed is increased as before. The motor is next connected to the 120 volt supply and this is continued until the field excitation has been reduced to its lowest safe value with the motor on the 240 volt mains. This provides a speed range of 1 to 12 with plenty of intermediate steps. All the speed changes are made with the use of a single controller whose operation is simple. The speed range may be increased by the use of gears. In this system the motor itself produces the larger part of the speed range, but it has certain disadvantages. The motor must be built to operate on the highest voltage, and both its power output and efficiency will be small on the low voltage supply. It requires the installation of a separate generating plant, and the wiring is somewhat complicated and expensive to install and maintain.

INTERPOLAR MOTOR.

The simplest, most efficient and satisfactory method of producing variable speed control is to use the single voltage supply and to vary the field excitation, which only gives a small range of speed variation, making necessary an extensive set of gearing. If the motor is underrated the speed may be varied from 1-3 without undue sparking taking place.

The cause of sparking as was stated before, is due to the distortion of the shunt field by the back ampere turns of the armature. Auxiliary poles, or interpoles as they are called, are placed between the shunt field poles and are connected in series with the armature. The magnetic field produced by these poles is in the opposite direction to the field produced by the back ampere turns of the armature and is equal to it at all times because the same current flows through both. The auxiliary field not only neutralizes the armature field, but it steadies the shunt field and provides sparkless running for the motor.

The use of these interpoles makes it possible to vary the speed of a shunt motor from 1 to 4 and even from 1 to 6 without producing sparking at the brushes. The method is very simple, all the parts are self contained and there is no expensive wiring system to install.

CONTROLLERS.

The style of controller used to start and to regulate the speed of the motors in both the multi-voltage and the auxiliary pole systems, is somewhat similar in their construction and operation. The principal difference is that the multi-voltage type employs extra contacts for connecting the motor to the successive voltages, and the other only applies a single voltage. Both types of control employ a field rheostat for their running notches and for producing the intermediate speed steps. Therefore a description of one will suffice.

The variable speed controller for the interpolar motor has only from four to six starting notches. These notches are similar to those of the railway controller and serve to apply the full voltage to the armature by cutting out the resistance step by step. The first notch throws the full excitation upon the shunt field. The resistances for starting these motors are light, compared to those of a railway motor.

All of the starting notches are first passed through before the running positions are reached. These are from 10 to 20 or more in number depending upon the smallness of the intermediate steps. A series railway controller only possesses two running notches. No change is made in the shunt field excitation during the application of full voltage to the armature. As the controller handle is advanced through the running positions a contact finger passes over successive contacts on the field rheostat and introduces resistance in the shunt field circuit. This weakens the field and the motor speeds up as was explained before.

These field rheostats differ widely from the ordinary type of starting rheostat. The field of a shunt motor is of a high resistance and takes only a very small current compared to that of the armature. For this reason field resistances are made of light wire. These wires are sometimes supported on the lower side of an iron frame by enamel, brass contacts are tapped in at the proper points, and project through the frame from which they are insulated. A contact finger passes over them and cuts more resistance into the field circuit, as the controller handle is advanced. This construction is very compact and light and the field rheostat occupies a very small amount of space. As the field current is low, only a very small amount of power is wasted in the rheostat and this is therefore a very economical type of control.

The controller is generally built with only one handle that not only starts and controls the running notches, but also reverses the direction of rotation. The handle is turned in one direction for forward motion and in the opposite for reverse. An equal number of running notches are sometimes provided for both forward and backward running, although this is not always the case. A catch is arranged so that it is impossible to carry the handle past the off position on stopping and so prevents the sudden reversal of the motor.

The controller, itself, may be located some distance away from its handle. In order that the lathe operator shall not loose any time in adjusting the controller to give the proper speed, the controller handle is mounted on the apron of the lathe and connected to the controller proper by means of a spline shaft and gearing. On different types of machine tools it is located in the most convenient positions.

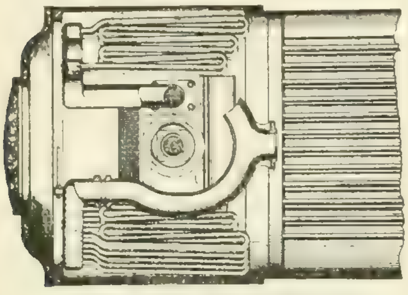
PRESENT PRACTICE.

When variable speed control was first applied to machine shop construction there was a tendency to carry it to excess and every tool, even the smallest, had its individual motor. As a general rule at the present, it is not considered advisable to equip all machine tools with individual motor drives, only the larger and more important machines are so equipped, the others being driven in small groups by constant speed motors.

Patent Office Department

SUPERHEATER.

A superheater has heen patented by U. B. Oatley, Schenectady, N. Y., No. 902,440. As shown in the accompanying illustration, the device comprises a combination with a steam boiler of a vertical header or casing, supported in the smokebox adjacent to the front end and side of the smokebox and comprising sep-

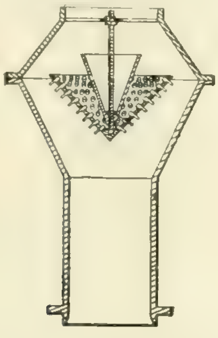


FRONT END SUPERHEATER.

arate saturated and superheated steam compartments. There are a number of loops or bends of superheater pipes connected to the superheated steam compartments. There is also a steam supply connection opening into the saturated steam compartment, and a delivery connection leading out of the compartment. We understand the patent has been assigned to the American Locomotive Company.

SPARK ARRESTER.

Alfred Hall, Edmonton, Alberta, Canada, has patented a spark arrester, No. 901,807. The device comprises an inverted hollow cone having openings therethrough and semicircular projections on



LOCOMOTIVE SPARK ARRESTER.

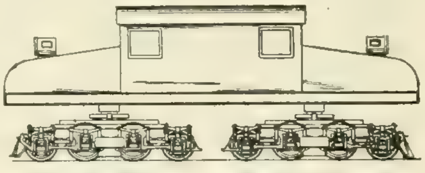
the outer face of the cone. The projections surround the upper half of each opening. Tubes pass through the openings and extend outwardly beyond the cone. The device is attached in an upper enlargement of the smokestack.

NEW FORM OF RAILROAD TIE.

United States Letters-Patent No. 884,190, dated April 7th, 1908, for new and useful improvements in railroad ties, have been granted Colonel A. Murphy, Chatfield, Minn. The invention is directed to cross-ties to be constructed of different classes of material, preferably steel, and the object is to provide a tie which is cheap, durable and efficient, and one that can be readily applied to use. The tie is particularly designed to prevent any spreading of the rails, and having a resilient rest for the rail by means of a block of wood disposed in each end of the tie. The tie proper is substantially trough-like in cross section and having its edges bent over to form ledges. These reinforce the walls of the tie and co-operate with the combined covering and rail securing members; when the rails are seated in the ways they will be held against lateral movement by the base of the rails engaging the adjacent portions of the tie and said rails thus prevented from spreading, the rail engaging ends being tapered so that they will fit against and over the base of the rail, conforming snugly thereto.

ELECTRIC LOCOMOTIVE.

W. Dalton, Schenectady, N. Y., has patented an electric locomotive, No. 902,476. The device embraces the combination of a a main frame, cab, and the ordinary ac-



ELECTRIC LOCOMOTIVE.

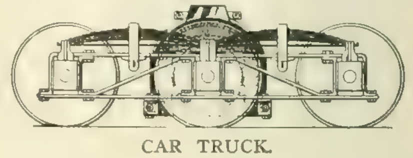
cessories therein, and a truck pivotally connected thereto and provided with pairs of guide wheels journaled adjacent to its ends, and a plurality of pairs of wheels journaled intermediate to the guide wheels. We learn that the patent has been assigned to the American Locomotive Company.

JOURNAL BOX.

A journal box for cars has been patented by Mr. J. G. Smith, Covington, Ky., and assigned to the Railway Journal Lubricating Company, Cincinnati, Ohio. No. 903,334. In addition to the usual form of a journal box the device is provided with a separate cellar consisting of a flat bottom box provided with hollow legs projecting below the plane of the floor. There are springs in the hollows of the legs for supporting the tray and the resiliency of the springs is such as to retain the tray with its contents against the lower face of the axle bearing. The device has the merit of being substantial and simple in construction.

CAR TRUCK.

A. F. Batchelder, Schenectady, N. Y., has patented a car truck, No. 901,944. There are three axles in the truck having wheels and journal boxes for the axles, and side frames in which the journal boxes may move vertically. There are springs for supporting the frames on the journal boxes, a motor armature on the middle axle, and a one-piece frame sup-



CAR TRUCK.

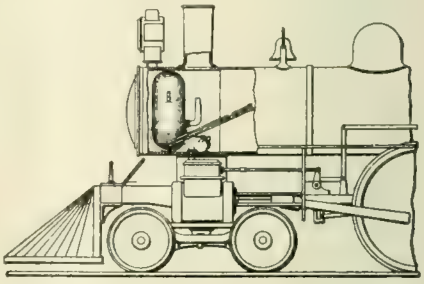
ported on the side frames and extending over the middle pair of wheels and over the side of the armature. The one-piece frame is adapted to serve both as a bolster and a motor field frame.

OIL BURNER.

A. D. Lee, Brookline, Mass., has patented an oil burning device, No. 903,736. It consists of a casting provided with a plurality of inlets and a single outlet; of a plurality of tubular members with the casing adjustable longitudinally, having their discharge outlets in alignment with that of the casing and having a plurality of spiral grooves extending lengthwise of the wall, and an inlet to the interior of each of the tubular members communicating with one of the casing inlets.

FEED-WATER HEATER.

A feed-water heater for use on locomotives has been patented by I. H. Kidwell,



FEED WATER HEATER.

Staunton, Va., No. 901,245. It comprises an annular shell, the shell being provided with heads spaced apart from each other to form a chamber, an inclined partition dividing the chamber into two portions, one of the portions being connected with the exhaust of the locomotive, and the other with the stack. Steam tubes extend lengthwise within the shell, and open into the chamber. The plates in the shell have openings for the circulation of water.

THE *A B C* SYSTEM OF TRAIN DISPATCHING

By A. Beamer. Superintendent Idaho Division

NORTHERN PACIFIC RAILWAY

The A B C System of train dispatching and block rules has been in operation on the Northern Pacific for a little over a year, first on a territory of nine miles over which we handle from 35 to 50 trains per day, then over additional territory covering one entire dispatching district of 63 miles, and since the 10th of October over a territory of a little over 500 miles, from Trout Creek, Mont., to Auburn, Wis., on Puget Sound, and arrangements are now being made to install it from Trout Creek to Billings, Mont. The value of the system was demonstrated from the time it was first put in operation and the extreme safety of the method, added to its great saving in the matter of quick movement of freight trains, are the features that have commended it to our people and resulted in its extended use.

Briefly stated, the operation contemplates doing away entirely with the time card and the Standard Rules governing train movement, and substituting therefor rules requiring all trains to stop at all telegraph offices unless they are provided with a block card authorizing their movement to the next telegraph office. The only authority any train has to move consists of a block card issued by the train dispatcher, checked and endorsed by the operator at either end of the block concerned. Meeting and passing points are arranged by the dispatcher and instructions given trains in all cases one block in advance. The instructions provide which train will take siding and which will hold main line. Since there is no time card, there can be no right by direction or right by classification. Train and enginemen must implicitly follow the instructions given them on the block cards.

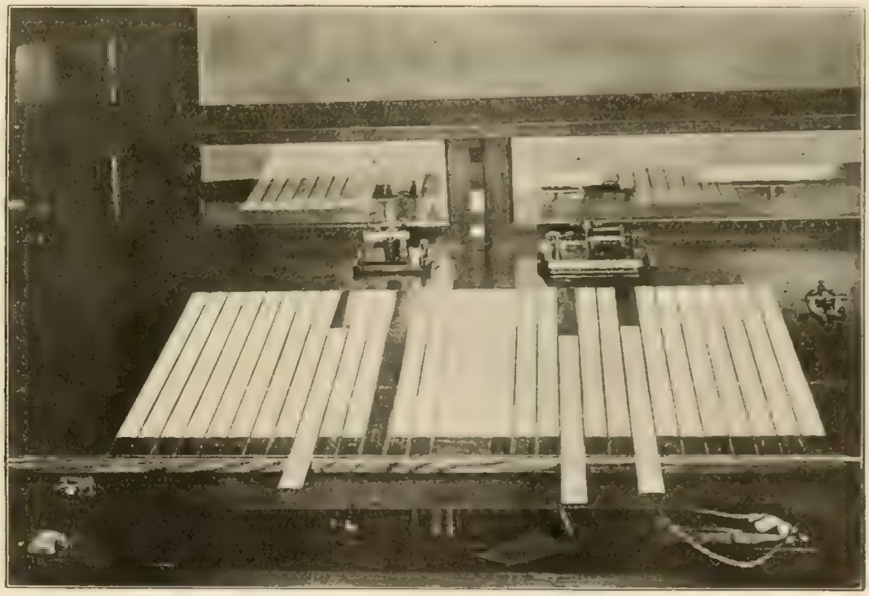
Dispatchers are prohibited from calling operators to put out block cards to approaching trains. We insist on the operator calling the dispatcher in all cases, the object being to insure the operators blocking between themselves in accordance with the rules. This matter of blocking between themselves is conducted over a block wire which extends only from one telegraph office to the next, and it has to be done without any supervision on the part of the dispatcher. If the operators should fail to block between themselves, the operator at the block office in advance would have no knowledge of the approaching train until it got in sight, and even then he would have no knowledge of the number of the engine until it was close enough at hand so that he could distinguish it, in which event it would be necessary for him to stop the train in order to arrange for the card, and when a train is stopped someone has to explain.

All trains are known by the number of the engine pulling them. We stop no trains to get orders, or rather block cards. The cards are prepared one block in advance, and when the signal shows clear the train comes down the main line without reducing the speed and the card is handed up by the operator, one copy to the engineer, another copy to the conductor, the operator using the ordinary rattan hoop for that purpose. Our passenger trains find no difficulty in picking up these hoops running at a speed of 45 miles per hour. In the event of the signal showing clear, and for any cause either the engineer or the conductor fails to get the card, the train is brought to an immediate stop and will not proceed without the written evidence that the signal means what its indication shows.

The dispatcher, instead of using the ordinary train sheet for recording train movements, is provided with a table in which are a sufficient number of slots, in which are placed strips of heavy paper 2½ ins. wide, on which are printed the names of the stations, the distance between stations and the usual heading provided at the top of the column on a train sheet for showing the engine number, conductor and engineer, etc. These slips are plugged into the table so they cannot be moved, and the station names are in exact alignment with a list of the stations on the district which is permanently fastened to the middle of the table. This list in the middle of the table represents the list shown on the ordinary train-sheet and furnishes all information as to side track capacity, distance between stations, distance between terminals, telegraph calls, coal and water stations, and everything of that nature ordinarily shown on a train-sheet.

The train slips are provided with three columns, one for recording the block card number under which the dispatcher authorizes the movement, the next column for recording the arriving and departing time of the train, and the third column of the slip, approximately 2 ins. wide, is used for recording the exceptions made by the dispatcher on the card when it is issued.

These exceptions are abbreviated and shown on the train-slip in the same manner as meeting and passing points are shown on the time-card, that is, an exception reading "H M M 1350" would be understood to mean, "Hold main line and meet engine 1350"; an exception reading "T S M 1350," would be interpreted to mean, "Take siding and meet engine 1350"; an exception reading "T S 1350 P," would mean, "Take siding and let 1350 pass." The block card number and the exceptions are always shown in the space provided for the block ahead of the train, so that the fact of the block being occupied is plainly apparent to the dispatcher, and with even ordinary care there is no danger of his overlooking the fact. He has not to keep any train



THE A B C DISPATCHING TABLE. NORTHERN PACIFIC.

order book, and all of his work, including the delays that may occur to a train, is done on the train slips.

To illustrate the actual operation of the A B C System: A train pulled by engine 1619 is ready to leave Spokane. Conductor asks the operator for card to Yardley; the operator consults his block sheet, which is a miniature train sheet, covering the movement of trains in the block on either side of him only, he finds that the block between Spokane and Yardley is clear; calls the dispatcher on the train-wire and says to him, "B 1619 to Yardley," spelling out the word "Yardley." If the dispatcher's record of the block being clear is the same as that of the operator asking for it, and there are no trains to be met or trains to pass at Yardley, the dispatcher responds, "B C 24 1619 to Yardley, O. K. 2.10 P. M." The operator is not required to repeat the card back to the dispatcher. If a train is to be met at Yardley the dispatcher's response would be, "B C 24 1619 to Yardley except hold main line (or take siding), and meet 1350." In which case the operator at Yardley would repeat the card to the dispatcher, who would then give his O. K. Following the receipt of the card from the dispatcher, the operator at Spokane then calls the operator at Yardley on the block wire and says to him, "B 1619 to Yardley." If the record of the operator at Yardley corresponds with the record of the operator at Spokane and the record of the dispatcher, the Yardley operator will respond, "O. K., S. D." (Signal Displayed). In the event that the card carries an exception for trains to meet or pass at Yardley the operator at Spokane will, when he calls the operator at Yardley, say, "B 1619 except hold main line (or take siding, as the case may be), at Yardley and meet 1350." The operator at Yardley repeats the exception, following which the card is delivered to the conductor of the train and another copy to the engineer, the third copy being retained by the operator for his file.

Northern Pacific Railway Company

BLOCK CARD

1907

Block Card No

Conductor and Engineer

This card is authority for you to run to

except

(If no exceptions Operator will insert word "Blank")

Made at by Supt

Operator.

THE A B C BLOCK CARD.

Immediately the train leaves Spokane the operator reports its departing time to the dispatcher and likewise to the operator at Yardley. Immediately on receiving a report of the train having left Spokane the operator at Yardley will consult his block sheet and see if the block between Yardley and Trent (the next station in advance) is clear. If so he will call the dispatcher and ask for a card in the manner described above, securing it in the same fashion, place the cards in his hoops, throw the signal to clear and be prepared to hand them up when the train reaches his station. We do not stop any train to get these cards. The only stops made by our trains are for the purpose of meeting or passing or for handling business.

The improvement over the old system arises from the fact that when a train obtains a block card it has absolute rights to the block, and meeting points are only made when trains are faced up with but one passing track between them. The necessity for changing an entire combination of "19" or "31" orders, or restricting time-card rights, which is necessary under the Standard Rules, is entirely done away with. Therein lies the secret of the great improvement made in getting freight trains over the road. Our experience so far indicates that we are able to increase the efficiency of our single track freight operation 20 per cent., and this without in any way interfering with passenger train operation.

We have an advertising schedule of our passenger trains showing the schedule time at the different stations. This confers no running or train rights, whatever, and is simply used by our train and enginemen to indicate the time they are due at the various points where the train is scheduled to stop, and they understand that they must not pass those points in advance of the advertised time. At all points where they are not scheduled to stop they are allowed to pass at any time.

Under this system it is up to the train dispatcher to see that the passenger trains are given the best of it, and that they are allowed to get over the road on schedule time. The dispatcher is provided with a table showing the minimum time to be used by freight trains in making the run from one passing track to the next, and in the event that a freight train has that time, when a card is asked for, it is assumed they will make it, and they are given a positive meet, even with a passenger train. In fact, all meets are positive. There are no time restrictions of any kind.

All of our men, dispatchers, conductors, engineers and operators, have taken hold of the matter in the very best spirit, and this action on their part is in a great measure responsible for the excellent showing that we have been able to make. The reason that they do this is because, instead of having trains on the road long hours on account of meeting and passing trains, changing meeting points and orders of various kinds, they now move quickly, and men are on the road a much shorter time. They get more rest and they are paid on a mileage basis instead of being paid on an overtime basis. The dispatcher's work is simplified and he is given absolute power over the movement of trains, a thing he never had before. The operators' duties are simplified. An operator is concerned only in the movement of trains in the single block on either side of him.

We have numerous blind sidings in the territory above mentioned, where we make meeting and passing points the same as we did under standard operation. All these blind sidings are provided with telephone communication to the operators at either end of the block. Should anything occur affecting the movement of a train that is directed to meet or pass another at one of these blind sidings, the conductor of the train at the blind siding immediately reports by telephone, and receives any additional instructions that may be necessary for him. These instructions are given by the dispatcher through the operator at one or the other ends of the block concerned.

The Book of Rules is designed to be placed in the hands of the operators,

Northern Pacific Railway Co.

A. B. C. SYSTEM.
(Patent applied for.)

Date | No.

DIRECTION

TRAIN No.

CONDUCTOR

ENGINEER

ENGINEER

ENGINES

TIME ORDERED

Arr.	Dep.	
		TROUT CREEK
		5.7
		TUSCOR
		8.4
		NOXON
		4.3
		SMEADS
		5.2
		HERON
		6.9
		CAB

DISPATCHER'S TRAIN SLIP.

train and enginemen, and the instructions contained therein do not require amendment in order to make them applicable to any section of the country. We realize the fact that physical conditions and business conditions necessitate different kinds of operation, due to peculiar local circumstances, and that no hard and fast rule governing train movement is applicable to all sections. The changes in operation under the A B C System are made by special instructions given to the dispatcher's office only, and changes to suit changed conditions of business can be made in that way quickly without involving the understanding of a large number of train and enginemen and operators.

In describing the train slips used by the dispatcher in moving trains, a sample of which is enclosed, I neglected to state that as soon as a train reaches its destination the slip recording its movement is taken out of the table and filed away. The dispatcher, therefor, has in front of him at any time only the trains that are actually on the road, thereby doing away with the standard method of the dispatcher working with two and sometimes three train-sheets, thus materially reducing the possibility of accident, due to the dispatcher overlooking a train.

That the method of introducing the system may be made perfectly clear, I have sent you a copy of the bulletin issued at the time the rules were put in effect on my own division. I also enclose a photograph of the dispatching table and a sample of the block cards used.

Flat Wheel Club Dines Angus Sinclair.

About twenty-five years ago a few railroad and supply men of whom the leading spirits were, H. H. Vreeland, then general manager of the New York & Northern; McKelvey, general superintendent of the New York & Susquehanna; Frank Gannon, general manager of the Southern Railway; John D. Campbell, assistant superintendent of motive power of the New York Central; Thomas Millen, master mechanic of the New York & Northern; W. W. Thompson, road foreman of engines of the Manhattan Railway; John A. Hill, L. R. Pomeroy, F. W. Coolbaugh, Angus Sinclair and about fifteen others formed a club for social amusement. There were to be no officers or formal proceedings, but John A. Hill was asked to call the host together at such time and places as he considered desirable. When the first notice of meeting was sent out Mr. Hill announced that the Flat Wheel Club would hold its first meeting. The name Flat Wheel Club stuck.

The meetings were carried on for about ten years. The members met in some hotel, had a modest dinner, then exchanged stories of a highly edifying character varied by songs, Frank Coolbaugh generally bringing out uproarious applause by his rendering of the "Old Oaken Bucket." From some unexplained cause the meetings ceased and none had been held for about fifteen years, when the following notice was sent to all the old members, every one being still alive:

New York, Oct. 28, 1908.

Dearly Beloved:

Once upon a time, away back in the last century, there oft and regularly convened in this city of Sodom a few congenial spirits, known to all and sundry as the Flat Wheel Club.

Even in those days there was frost upon the polls of some of the chosen—most of them now are white.

But God has been good to the elect in that they live, kick and have their being.

All have changed positions, and like newly wedded couples, some have had luck and some have had children.

But each and all have clear heads, warm hearts and red blood.

Each and all remember the days of their youths and the railroading they did, and each still talks of it and is proud of it—what if some of them do lie about the number of cars they pulled?

Now some of the Republicans and Sinners, Scribes and Pharisees conceived the notion of giving old Angus Sinclair a dinner—just to hear him sing "We'll gang na mair a rovin'"—and lo! the company chosen was mostly the old gang, and so the head taster came to the old scribe with the goose quill and bade him summon the faithful to one more feed for auld lang syne.

Now this goes to all the fully avouched, the sworn legitimate, the blessed few, greeting, and to all their sometime guests.

You are bidden to assemble again in fellowship and good feeling, to forget all past differences, to forgive all those who didn't heed your sign to keep off the grass.

Let all the hoary-headed sons of sin gather around the table, and eat a few things, and drink a few things, and smoke a few things, as a sort of offering to the gods that they are alive.

Prizes will be given for the best railroad story, the best song and the biggest lie.

All will gather in the throne room at the Hardware Club, 253 Broadway, at 6:30 o'clock on the night of Wednesday, November 4, in this year of grace nineteen hundred and eight, and in the seventh year of the reign of our gracious majesty, Theodore the first by the grace of God, King, Defender of the Faith, Emperor, Pasha, Hoodoo and Corporation Tail-twister.

Now all this will cost you, oh! well, say, it costs $5.00—isn't that cheap for living fifteen years without once paying dues?

Come now all ye faithful of the old guard and write a letter to the undersigned, and mark it "in haste" and say just Yes.

And we will gather, without our zinc shirts and our open faced vests, for we will despise these things as we did of yore, and we will call each other by the first name and look into each other's eyes, and be boys again; for we live but once and that briefly, and we will be dead forever.

Jack of the Ink Pot, slid-flat to the Club, and known to the rest of the world as John A. Hill.

505 *Pearl street.*

Machine Tool Motors.

For driving machinery, motors of variable speed are generally required for individual applications and constant speed motors when a group of tools is driven through a section of shafting. Motors can now be obtained operating upon a single voltage with a speed ratio of 3 or 4 to 1, and in some cases even greater; but for railroad purposes we think that a change ratio of 2 to 1 generally sufficient, the additional variations being made by mechanical means. This enables one to use motors of a lower price than where a large speed ratio is considered important. It is perhaps only necessary to have the large variable speed ratio where a piece of work has to be faced in a boring mill from a large circumference down to a small central portion, and as such classes of work are rare in locomotive shops there seems to be little absolute need for the higher speed ratios. Three-wire and four wire multiple-voltage systems have been installed, but we doubt if there is sufficient to pay for the complication in wiring over the single-voltage method of speed regulation by field weakening. Alternating current motors are very satisfactory for constant speed work, but it is often thought advisable to limit the power current in one building to either the direct or the alternating, in preference to having a mixture of the two.

AMONG THE WESTERN RAILROAD MEN

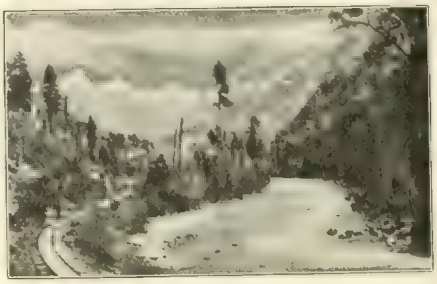
By James Kennedy

ON THE MISSOURI PACIFIC.

When you pass through the thronging gateway of the West at Kansas City and behold the parting smile of the dying day as it lingers lovingly over the fields of emerald and gold, you lie down to pleasant dreams closed in by the soft, silken curtained Pullman car. Next day, if there is not a new heaven there is a new earth. Far as the eye can reach the whitish gray sand of a pathless desert is around you. Habitations are few and far between. The railway men at the lonely stations seem to be the only human beings who have not turned their backs on civilization. One does not require to be a professor of geology to see that this treeless wilderness has been the bed of a salt sea. The convulsions that raised mountains on the earth's crust have raised this weary wilderness out of the primeval depths. The depress-

ROYAL GORGE, COLORADO.

ing monotony is relieved by a shining vision in the far horizon's rim. It is that of another railway where a train is winding eastward and a trail of white smoke lingers in a sky of cobalt. Night comes, and the silver moon is high in heaven, and by and by the glittering snow on Pike's Peak looms aloft in spectral whiteness. The serene and majestic outline of the towering mountains blots out the unpleasant memory of the dreary flat lands. Presently, in a blaze of electric fire, we are in Den-



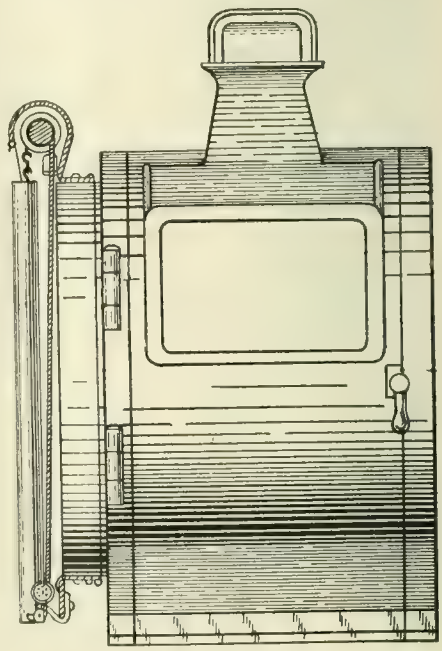
LES ANIMAS CANYON, COL.

ver. This imperial Queen City of the West shines like a glittering star on the breast of the Rocky Mountains. The heavenly constellations grow dim beside the looped and garlanded splendor of the city's lights. Spirals and crosses and crescents in glowing coruscations are flashing their myriad lights. Surely we are in a wonderful city in dreamland where the streets are of jasper and the walls are smooth as monumental alabaster.

THE COLORADO AND SOUTHERN SHOPS.

Next morning we are among the 500 skilled mechanics in the shops of the Colorado & Southern Railroad. Mr. H. C. Van Buskirk, the superintendent of motive power, has gathered around him a choice staff of able assistants. Mr. H. W. Ridgeway, master mechanic, is an especial favorite among the younger mechanics and railway men, whom he encourages with kindly words spoken at the proper time. Mr. C. E. Howell is in charge of the extensive roundhouse which includes 58 stalls, and we noted that a number of locomotives of the Santa Fe System are having their running repairs attended to as well as those of the Colorado & Southern. A compressed air engine moves the 80 ft. turning table, and there is a vast roominess about the roundhouse which admits of every modern appliance having proper space for its application. The concrete floor and pits, the lofty, finely-lighted ceiling, the perfect system of heating and ventilating, render possible the regular roundhouse work being done under conditions that approach comfortable convenience. In this regard the work of Mr. John C. Egan, the engine dispatcher, is worthy of imitation. His wrecking outfit is the most completely equipped train of its kind we have seen. There are five cars altogether; the dining car and kitchen apparatus, if not as elegant as Pullman's, is as substantial. Perhaps the most gratifying feature is the commissary department. Mr. Egan does not believe in sending a number of half-starved men out in a winter's night. It is not "from labor to refreshment" with them, but refreshment first and labor afterwards, and although the calls for the wrecking train are fortunately few and far between, when they do come they are met with a degree of alacrity that resembles the action of the New York Fire Brigade at a blazing Bowery rookery.

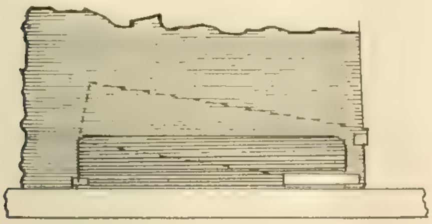
In the machine shop Mr. J. M. Davis, the general foreman, is ably assisted by Mr. C. J. Kennedy. The latter gentleman gave some interesting illustrations of doing work which were rather surprising. One of the largest locomotives undergoing repairs was lifted from its position by the travelling crane and dropped in another pit where the wheels were ready. It was not an accidental lowering to be afterwards wrestled with. The wedges and springs and saddles were in place and the ponderous engine was slid into perfect position on the six driving boxes, not to speak of the accompanying trucks, the whole operation occupying six minutes. Mr. Kennedy has the reputation of being an expert valve setter. He has arranged an air compressor for turning the wheels during the valve setting operation, and on engines where there are no new link saddles or new sectors he has a record of setting the valves in a half hour. We noticed a precautionary marking on the valve rods which is not usually made; that is the point where the valve strikes



HEADLIGHT SHADE.

the steam chest. Mr. Kennedy puts much value on this point and carefully marks the extreme valve travel during adjustment.

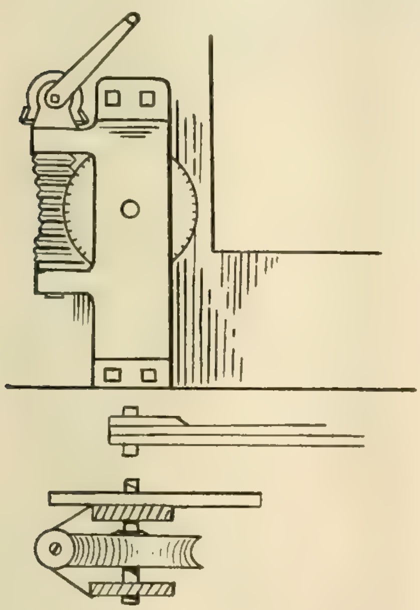
The copper and tin shop was of particular interest. Mr. C. A. Pratt, the foreman, is a master of his calling and



OPENING IN GRAIN DOOR.

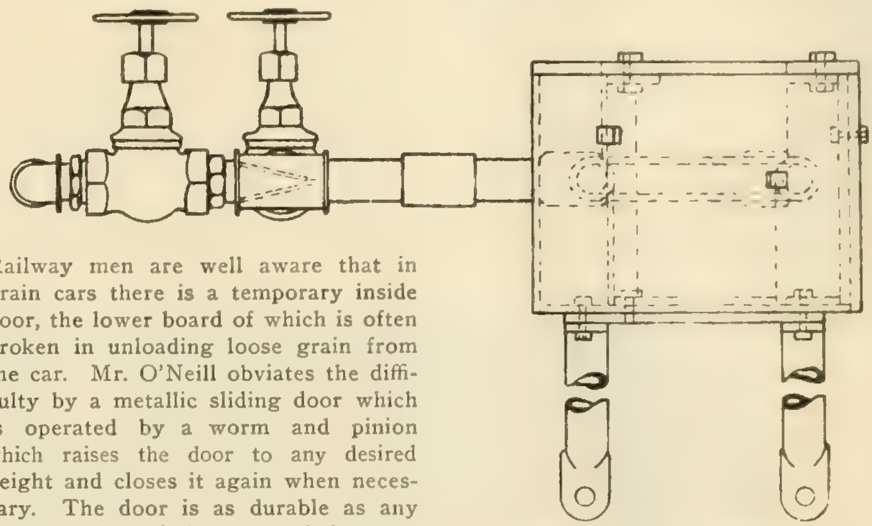
an inventor of real ability. In addition to a number of appliances used in brazing and soldering and pipe bending, all of which are of his own inventing and are models of their kind, he has also a number of devices in general use which are his innovations. He was engaged in perfecting a head-light curtain, the principle of which could be readily applied as a cab curtain, and its adoption would add greatly to the comfort and convenience of railway men when on a siding or otherwise waiting for their turn to proceed.

The boiler shop is in keeping with the other departments and is ably presided over by Mr. R. J. O'Neill, who is



GRAIN DOOR MECHANISM.

widely known as the inventor of many devices used in boiler making. Among these is a flue welder which is rapidly coming into general favor. It has the advantage of being readily adaptable to any size of flue, and will scarf, weld, swage and spread or fit flues to the holes, so that no shimming or lining-up is necessary. It runs 300 revolutions a minute and its capacity for work is only limited by the heating capacity of the furnace. We had the pleasure of seeing the machine in operation, and the changing from flues of 2 ins. diameter to flues of 4 ins. diameter was the work of only a few minutes. It may be stated that the welding of 4-in. flues previously cost 18 cents each. After the introduction of Mr. O'Neill's rapid adjustable welder the cost is under three cents each. Mr. O'Neill has completed the construction of a new door for grain cars.



BRAZING FORGE. COLORADO & SOUTHERN.

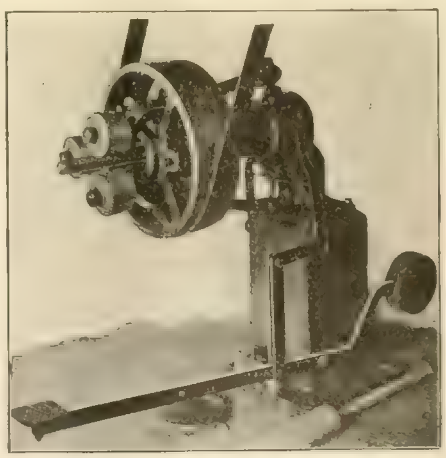
Railway men are well aware that in grain cars there is a temporary inside door, the lower board of which is often broken in unloading loose grain from the car. Mr. O'Neill obviates the difficulty by a metallic sliding door which is operated by a worm and pinion which raises the door to any desired height and closes it again when necessary. The door is as durable as any other portion of the car, and does not need renewing. Its general adoption would effect a saving in grain doors.

The narrow gauge engines used in the mountain service are interesting in view of their compact and massive construction. Their tractive power is very great and although some of the grades on the mountain are extremely steep and tortuous, there are very few failures recorded against these little giants. The track is 3 ft. 8 ins. gauge and the engines are of the six-wheel type. Altogether the shops of the Colorado & Southern at Denver are of particular interest, and there is a degree of perfection in the methods, as well as in the ingenuity and skill of the workmen, that one would hardly look for in a place that is usually considered as being, to some extent, removed from the beaten track of civilization. It is really a center in itself; limited it may be in magnitude, but altogether a model of enlightenment in the spirit that actuates the people of Colorado and makes a visit to this Queen City of the West something delightful to remember.

THE UNION PACIFIC SHOPS.

At Pullman, on the outskirts of Denver, the Union Pacific Railroad have a roundhouse of 50 stalls. The proportions of this building are so vast that the great locomotives look small in it. Mr. I. A. Turtle, the master mechanic, has had considerable experience in the Company's service, and was recently transferred from Omaha to this point. He seemed serenely satisfied with everything except an assortment of compound locomotives that occasionally mar the harmony of the situation. It seems that after every one of their many joints have been carefully fitted they do excellent work for about a couple of days and then they literally go to pieces again and it would require a gang of skilled workmen, busy day and night, keeping the joints tight.

In the machine shops the engines undergoing repairs are turned out in ten or twelve days. Of these there are about five per month, and although the machinery is not of the newest, the accommodations are of the amplest and Mr. Turtle is rapidly introducing new methods. Some trouble is experienced with the varieties of water used in the boilers. Every known device has been



O'NEILL'S RAPID FLUE WELDER.

tried in treating the water, but at the best it is not uncommon to have to replace an entire set of flues once a year. Some progress has been made and it is ascribed to the fact that a system has been devised of filling the

boiler with hot water, so that except during special repair the boilers are never allowed to cool.

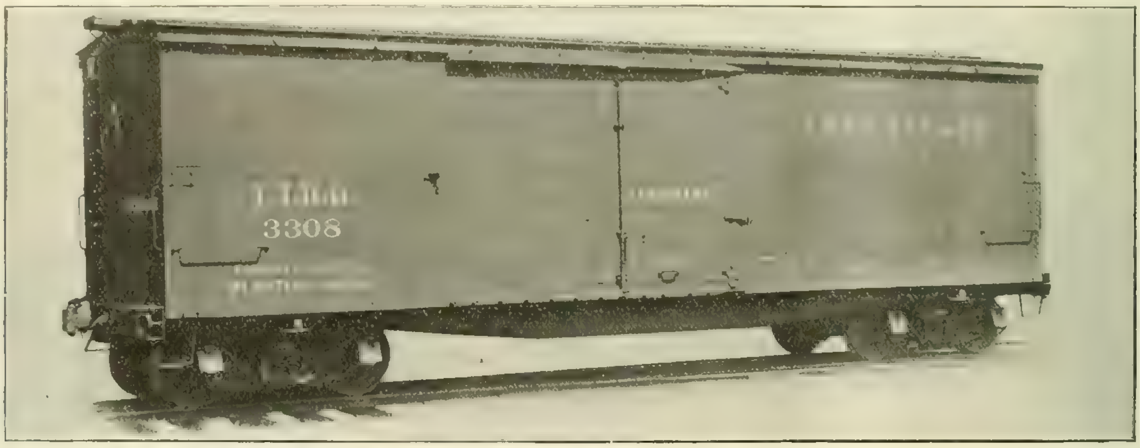
Four of the new gasoline motor cars used on the Union Pacific are kept in repair at the Denver shops. Their construction has been already fully described in the pages of RAILWAY AND LOCOMOTIVE ENGINEERING, but too much cannot be said of the elegant equipment of these cars. There is accommodation for nearly 100 passengers, and there is no question of their adaptability to the service required in a thinly populated country where the running of regular trains is necessarily at intervals of many hours. Forty-five new cars of this kind are already ordered for the service in Colorado and in Nebraska, and more are in contemplation. The motors are of the six-cylinder type and have the friction disc drive, consequently the speed is as variable as that of the highest powered steam locomotive. They are of 200 h. p. and carry 130 gallons of gasolene. A baggage car is generally attached and the average mileage of these cars is 135 per day. The entire structure, except the furnishings, is of steel, and the V-shaped ends of the cars are claimed to be an important safety feature in case of collision. It is gratifying to learn that this latter quality has not so far been severely tested, which speaks volumes in proof of the care and vigilance of the motormen, and the general excellence of the signaling and system of train operation on the Union Pacific.

The first snow plow used regularly upon an American railroad was designed by Herman Haupt, and built for use on the Pennsylvania Railroad. That was in 1849. Previous to that time crude pilot plows were used but the Haupt design was the prototype of the numerous push snow plows subsequently employed. The march of progress has, however, brought the powerful steam-driven rotory snow plough to the front on many of our railroads.

Long Island Box Car.

Our illustration shows a substantial type of box car built by the Pressed Steel Car Company of Pittsburgh for the Long Island Railroad. The car is a practically standard P. R. R. type of car, known as Class "XL," the light weight of which is 46,700 lbs. This car has a steel underframe, wooden superstructure, Tower couplers, Westinghouse friction draft gear, Westinghouse air brakes, arch-bar trucks with pressed steel bath-tub type of truck bolsters.

The general dimensions are as follows: Length over end sills, 38 ft. 6 in.; length outside over body, 37 ft. 1½ ins.; length inside, 36 ft.; width outside over body, 9 ft. 4½ ins.; width inside, 8 ft. 6 ins.; width at eaves, 9 ft. 10 ins.; height inside, floor to carline, at side plate, 8 ft.; height from rail to floor, 3 ft. 6¾ ins.; height from rail to eaves, 12 ft. ¼ in.; height from rail to running board, 12 ft. 8⅝ ins.; heights from rail to top of brake staff, 13 ft. 2⅝ ins.; distance from center to center of trucks, 28 ft. 6 ins.; size of journals, 5½x10 ins.



LONG ISLAND BOX CAR WITH PRESSED STEEL UNDERFRAME.

Experiments have been made at the University of Illinois, to remove from bituminous coals the heavy hydro-carbons, and to produce a fuel essentially smokeless. Efforts were made to produce artificially, from Illinois coals, material which would be sufficiently like anthracite to supply the demand for that kind of fuel. The striking interest in these experiments lies in the fact that the temperatures for rapid oxidation, especially with finely divided coal, are sufficiently low to bring this material within the range of conditions which are frequently met in storage. These results, therefore, have a direct bearing upon the weathering of coal, its spontaneous combustion, and probably, also, to a certain extent, upon the problems involved in mine explosions.

At a temperature not exceeding 400 degs. C., a sufficient amount of hydrocarbons may be driven off to leave a substance closely resembling in composition the coals of the Pocahontas type. This material is exceedingly friable, and needs to be subjected to the process of briquetting. It has some of the characteristics of coke, but burns readily, and is clean and smokeless. The commercial possibilities for the production of a smokeless fuel of this type have not been taken up.

Copies of Bulletin No. 24, issued by the university, may be obtained gratis upon application to the director, Engineering Experiment Station, Urbana, Ill.

Even Great Men Have It

A good story of Morse, the inventor of the telegraph alphabet, is told by the *Dundee Advertiser* under the heading, "The Absent-mindedness of Genius." It indicates that long concentrated thought in one direction may possibly have the effect of limiting it in another. The story goes: "The absentmindedness of great thinkers is a well known phenomenon. When Morse had completed his wonderful telegraphic system he confessed to a difficulty which appeared to him almost insurmountable. 'As long as poles can be used,' he said to a friend on day, 'it is easy. But what must be done when we come to a bridge? We cannot use poles there, and the wire would break of its own weight without some support.' 'Well,' replied the friend, 'why not fix the wires to the bridge?' Morse looked at him thoughtfully for a moment and then exclaimed, 'I never thought of that. It's the very thing.' This instance of mental concentration on one leading idea to the exclusion of all others is almost as remarkable as that told of Sir Isaac Newton, who cut a hole in his study door to allow his favorite cat to come and go freely, and then cut a smaller one for the use of her kitten."

Items of Personal Interest

Mr. C. A. Austin has been appointed train master of the Lehigh Valley Railroad, with offices at Jersey City, N. J.

Mr. D. D. Robertson has been appointed master mechanic of the Wyoming division of the Lehigh Valley, vice Mr. A. M. McGill, promoted.

Mr. C. T. O'Neal has been appointed superintendent of the Buffalo division of the Lehigh Valley Railroad, vice Mr. R. W. Baxter, promoted.

Mr. John Mooney has been appointed assistant superintendent of motive power of the Grand Trunk Pacific, with headquarters at Rivers, Man.

Mr. W. W. Abbott has been appointed superintendent of the New York division of the Lehigh Valley Railroad, vice Mr. C. T. O'Neil, transferred.

Mr. A. J. Wade has been appointed master mechanic of the Louisiana & Arkansas Railroad at Etamp, Ark., vice Mr. F. A. Symonds, resigned.

Mr. A. C. Tully, purchasing agent and general storekeeper of the New York City Railway, has resigned and will engage in other business in New Jersey.

Mr. H. V. Wallingford, inspector of bridges and buildings of the Atchison, Topeka & Santa Fe Coast Lines at San Bernardino, Cal., has resigned.

Mr. J. K. Witman has been appointed superintendent of materials and supplies of the Philadelphia & Reading Railway, vice Mr. John H. Rankin, deceased.

Mr. E. E. Bashford has been appointed assistant purchasing agent of the Mexican Central Railway, with offices at New York, vice Mr. E. A. Mason, resigned.

Mr. J. R. Spragge, formerly road foreman, has been appointed district master mechanic on the Canadian Pacific Railway, with headquarters at West Toronto, Ont.

Prof. S. J. McLean, of the University of Toronto, has been appointed a member of the Canadian Railway Commission, and not Mr. Wm. Galliher, as previously stated.

Mr. R. F. Kilpatrick, late of the D., L. & W., has been appointed assistant superintendent of motive power of the Denver & Rio Grande, with offices at Burnham, Col.

Mr. C. L. Guest has been appointed West-bound Freight Agent of the Lehigh Valley Railroad Co., with office at 707 Railway Exchange Building, Chicago, Ills.

The jurisdiction of Mr. J. M. James, master mechanic on the Pennsylvania Railroad, will be extended to include the Buffalo division on that road, owing to the retirement on pension of Mr. Allen Vail.

Mr. J. F. Maquire has been appointed general manager of the Lehigh Valley Railroad Company, with offices at South Bethlehem, Pa., vice Mr. M. B. Cutter, resigned.

Mr. R. W. Baxter has been appointed superintendent of transportation of the Lehigh Valley Railroad, with offices at South Bethlehem, Pa., vice Mr. J. F. Maquire, promoted.

Mr. Alfred R. Kipp, formerly master mechanic of the Wisconsin Central, has been appointed superintendent of motive power on that road, vice Mr. W. G. Menzel, resigned.

Mr. J. T. Connor, general foreman of the Houston & Texas Central, at Ennis, has been appointed acting superintendent of motive power and machinery in place of the late Samuel Millican.

Mr. R. A. Belding has been appointed general agent of the freight department of the Chicago Great Western Railway, with headquarters at 305 Broadway, New York, vice Mr. W. H. Burk, resigned.

Mr. Manley B. Cutter, for the last ten years general manager of the Lehigh Valley Railroad, has resigned to accept a similar position with the Minneapolis, St. Louis & Iowa Central Railroad.

Mr. J. S. McCrea has been appointed New England Freight Agent on the Lehigh Valley Railroad, with offices at 262 Washington street, Boston, Mass., vice Mr. C. L. Guest, transferred.

Mr. R. E. Smith, formerly road foreman of engines of the Canadian Pacific at Medicine Hat, Alb., Can., has been appointed master mechanic on the same road, with headquarters at Medicine Hat.

Mr. Albion, formerly foreman of locomotives of the Ontario division of the Canadian Pacific Railway, has been appointed district master mechanic on the same road, with offices at West Toronto, Ont.

Mr. J. H. Cummings has been appointed traveling agent for the Chicago Great Western Railway for the State of Nebraska, with headquarters at Lincoln, Neb., vice Mr. C. A. Musselwhite, resigned.

Mr. F. K. Tutt, master mechanic of the Missouri Pacific and St. Louis, Iron Mountain & Southern Railway, at Osawatomie, Kans., has been appointed master mechanic at St. Louis, vice Mr. J. J. Reed, resigned.

Mr. E. V. Connelly has been appointed purchasing agent of the Pittsburgh & Lake Erie. He has been chief clerk of the department and in the company's service for ten years. His headquarters are in Pittsburgh.

Mr. C. W. Alleman, of the Pittsburgh & Lake Erie's motive power department, has been elected secretary of the Railway Club of Pittsburgh, vice Mr. John D. Conway, who declined a renomination after several successful terms in which he rendered efficient and valuable service to the club.

Mr. James Oborne, general superintendent of the Ontario division of the Canadian Pacific Railway, was recently married in Quebec to Miss Edith Maud Simpson, daughter of the late Thomas Simpson, chief superintendent running department, Great Western Railway of England.

Mr. W. H. Pearue, of Glasgow, Scotland, one of our subscribers, has been appointed chief engineer of a large rice mill belonging to Steel Brothers, Rangoon, Burmah. Mr. Pearue says that he received much valuable assistance in his engineering studies from the pages of RAILWAY AND LOCOMOTIVE ENGINEERING.

Mr. Edward Elden, formerly master mechanic on the New York Central Lines at Buffalo, N. Y., has associated himself with the Dodge Mfg. Co., Mishawaka, Ind., as chief of sales of their railroad department. The many friends of Mr. Elden, in both railroad and supply business, will be pleased to learn that he has connected himself with this reliable firm.

Mr. Paul J. Kalman, railroad representative of the Detroit Seamless Steel Tubes Company, of Detroit, Mich., is now handling in St. Paul and Minneapolis, a full line of seamless steel tubing, manufactured by this company, including stationary boiler flues and mechanical tubing for automobile construction, and for other purposes. Mr. Kalman's headquarters are in the Pioneer Press Bldg., St. Paul, Minn.

Mr. Warren L. Boyer, formerly with the Peckham Truck Company, and later on with the New York Car & Truck Company, at Kingston, N. Y., has become associated with the American Brake Shoe & Foundry Company as assistant in the engineering department. His duties will be to look after the standardization of brake heads and brake shoes on the lines of the standards of the American Street & Interurban Railway Association.

Mr. F. P. Roesch, formerly master mechanic on the Southern Railway, has been appointed master mechanic on the El Paso & Southwestern Railway at Douglas, Ariz. Mr. Roesch is a valued contributor to our pages. His observations on matters con-

nected with the mechanical department of railways are always read with deep interest. His original investigations and his thoughtful consideration of the subjects he takes up are calculated to advance practical knowledge in railway matters.

Mr. L. F. Loree, president of the Delaware & Hudson Railroad, has been made a director of the Baltimore & Ohio to look after the Harriman interests in the latter company. Mr. Loree is one of the few higher railroad officials who rose through the engineering department, that opportunity having been given to him by the Pennsylvania Railroad Company. Besides having been a very able engineer, Mr. Loree has displayed high executive and business ability. He is still a young man, having been born in 1858. After graduation from Rutgers College he entered the engineering department of the Pennsylvania Railroad in 1877. A few years later he was in the engineer corp of the U. S. Army. In 1883 he returned to railroad service, performing engineering duties on different railroads. For several years he was general manager of the Pennsylvania Lines West of Pittsburgh. Then he was president of the Baltimore & Ohio for a time, so he is well fitted to act as a director.

Mr. J. D. Harris has been appointed general superintendent of motive power of the Baltimore & Ohio Railroad, with offices at Baltimore, Md., vice Mr. J. E. Muhlfeld, resigned. Though only a young man, Mr. Harris has risen to his present important position in the railroad world step by step, having begun as a machinist apprentice on the Pennsylvania lines West, October, 1889. After serving his apprenticeship he worked as a machinist and as a locomotive fireman until March, 1895, when he was made assistant foreman and afterward foreman of the machine shops of the Pittsburg, Fort Wayne & Chicago Railroad. From February 1, 1897, to July 1 of the same year, he was assistant road foreman of engines, and from July 1 to January 1, 1898, was assistant engineer of motive power of the Northwest system of the Pennsylvania lines. From January 1, 1898, to October 1, 1899, Mr. Harris was master mechanic of the Eastern and Toledo divisions of the Pennsylvania, with headquarters at Crestline, Ohio. October 1, 1899, until 1901 he was master mechanic of the Cleveland & Pittsburgh road. From that time until 1903 he was assistant to the general superintendent of motive power of the Baltimore & Ohio, which position he resigned to become assistant chief engineer and works manager of the Westinghouse Company. He has now returned to the B. & O. as head of the motive power department.

Obituary.

William H. Nye, a locomotive engineer on the Lake Shore & Michigan Southern Railway, died at his home in Buffalo last month. He was for forty years in the service of that road, and ran the last wood-burning locomotive operated over the line. He became an engineer in 1880, and during the twenty-eight years that he was on the footplate never had an accident. He was credited with some of the fastest runs made between Buffalo and Cleveland.

In closing the personal columns of our paper for this year we have to chronicle the death of Alexander Mitchell, one of the pioneers in the mechanical department of the Lehigh Valley Railroad. Mr. Mitchell was an able mechanic and a skilful designer, and his abilities were displayed in the days when many of the problems of locomotive building which are familiar to us were unsolved. Mr. Mitchell's early railroad work was done on the Beaver Meadow Railroad, where he was for some time a locomotive engineer. Two locomotives built by the Niles Locomotive Works of Cincinnati were taken over in 1864 by the Lehigh Valley when the smaller line was absorbed. These engines were equipped with Walschaert's valve gear, and Mitchell was the only man belonging to the road who seemed to understand them. This led to his promotion to the rank of master mechanic. In 1866 the Lehigh Valley Railroad acquired the Lehigh and Mahanoy railroad, and that transaction was then spoken of on the road as the consolidation. Alexander Mitchell turned out at the time the first engine of the 2-8-0 type, which he called the Consolidation in honor of the corporate union of the two roads. The name Consolidation has ever since been used to designate the type of which Mitchell's engine was the first. About this time the management, finding that they were in possession of a great variety of types of locomotives owing to the acquirement of various smaller properties, put upon their master mechanics the responsibility for the production of locomotives suitable for all kinds of road service. Mitchell, who had built the first consolidation, endeavored to improve on that design by an engine of the 2-10-0 class. This has since been called the decaped type, but in Mitchell's design the engine did not curve very well and later a pair of carrying wheels was substituted for the rear pair of drivers. The altered engine then became the prototype of the modern "Mikado" or 2-8-2 engine. In the early days of locomotive construction these were notable achievements, and Mitchell's work has remained as part of the inheritance of the mechanical world to-day. Mr. Mitchell's home after he retired from active service was in Wilkes-Barre, Pa., and his death, which occurred in Asbury Park, N. J., last summer, has removed a remarkable figure from the ranks of the "old guard" among railway men.

Conventions Go to Atlantic City.

The regular meeting of the joint executive committee of the Master Mechanics' and Master Car Builders' associations was held about the middle of November in the United Engineering Societies' building in New York. Atlantic City was the place decided upon for the June conventions of these associations. Next year the Master Mechanics' Association's convention comes off first, beginning on Wednesday, June 16 and continuing on the 17th, 18th and 19th June. The Master Car Builders' Association meets Monday, June 22 and continues on the 23d, 24th and 25th June. It was stated that the facilities for exhibition purposes at Atlantic City will be better than ever.

The officers elected at the last meeting of the New York Railroad Club were: President, Mr. J. F. Deems, general superintendent of motive power, rolling stock and machinery of the New York Central Lines; first vice-president, Mr. W. G. Besler, general manager of the Central Railroad of New Jersey; third vice-president, Mr. Frank Hedley, general manager of the Interborough Rapid Transit Company; Mr. R. M. Dixon was elected treasurer of the club. The new members of the executive committee elected at this meeting were Messrs. E. T. Campbell and G. H. Campbell. Mr. Geo. W. West remains an executive member, and this year the elected member of the finance committee was Mr. B. A. Hegeman, Jr. Messrs. Richard L. Thomas and Otis H. Cutler are the other members whose terms of office have not yet expired.

Locomotives for the A. T. & S. F.

The Baldwin Locomotive Works have recently completed an order for 49 locomotives for the Atchison, Topeka & Santa Fe Railway. Seven of these engines are of the Pacific type for passenger service, and 42 are of the consolidation type for freight service. All are equipped with single expansion cylinders, piston valves, Walschaerts valve motion and smokebox superheaters. Ten of the consolidation type locomotives are equipped for coal burning while the remainder, including the Pacific type engines, are arranged for burning oil. The Atchison, Topeka & Santa Fe have for some time been operating a ten-coupled locomotive with a smokebox superheater, and the successful performance of this locomotive has resulted in the adoption of superheated steam at a comparatively low pressure on the engines now under notice.

The Pacific type locomotives shown in our half-tone illustration have 25 x 28 in. cylinders, driving-wheels, 73 ins. in diameter, and as the safety valves are set at 160 lbs., the calculated tractive force is 32,600 lbs.

The cylinders are designed for double front frame rails, and are equipped with inside admission piston valves 13 ins. in diameter. The steam chest center lines are placed 6 ins. outside the cylinder center lines. The valves have a steam lap of 1⅛ ins., and an exhaust clearance of ⅛ in. They are set with a constant lead of ¼ in. and have a maximum travel of 6¼ ins. The relief valves are of the style used by the Pennsylvania on their piston valve locomotives. The live steam ports are extended up to a horizontal face placed above the steam chest. The ports are covered by a plate, which, when the throttle is open, is held on its seat by steam pressure acting on its upper surface. Should the pressure underneath become excessive, the plate is lifted from its seat, and communication is thus established between the two ends of the cylinder.

The location of the steam chests makes it possible to use a direct form of valve motion with all parts placed in practically the same vertical plane. Each link is carried by two cast steel bearers which are bolted, in front, to the guide yoke, and at the back, to a suitable support. The valve rod is carried on a bearer bolted to the top guide, and is rectangular in section.

The front truck is of the swing bolster type, with cast steel saddle and three point suspension links. The rear truck is of the Rushton pattern with outside journals. The engine truck and tender wheels are steel tired with cast-steel spoke centers, all of which were manufactured by the Standard Steel Works. The weight is distributed in these engines so that the driving wheels carry 140,400 lbs., the front truck 54,950 lbs. and the back truck 37,400 lbs., giving a total for the engine of 232,750 lbs. When the weight of the tender is added the total comes up to 395,000 lbs. The driving wheel base of the engine is 12 ft. 8 ins., that of the whole engine is 34 ft. 5 ins. and with the addition of the tender the wheel base is 65 ft. in all. The boiler is straight topped, with sloping throat and back head. The tubes are 20 ft. in length. The barrel is built up of four rings, which have diamond butt-jointed seams on the top center line. The firebox is radially stayed, and the front end of the crown is supported by two T irons. All firebox rivets are countersunk on the inside. Washout plugs are liberally provided in the front tube sheet, back head and water legs; also on the lower center line of the barrel, along the water level, and in the outside sheet just below the firebox crown. The superheater is of the smokebox type, as developed by the Baldwin Locomotive Works. The final passage of the steam is made through the tubes at the back of the smokebox, where the gases are hottest. The joints between the tube plates and drums are made tight with copper gaskets. The tender frame is built of 12 in. steel channels with wood bumpers, and the trucks have arch bar frames, cast-steel bolsters and triple elliptic springs. The tank has a water bottom.

HEAVY 4-6-2 FOR THE ATCHISON, TOPEKA & SANTA FE.

W. F. Buck, Supt. Motive Power — Baldwin Locomotive Works, Builders

The consolidation type locomotives have cylinders 24 ins. in diameter by 32 ins. stroke, and this, with 57-in. driving wheels and a steam pressure of 160 lbs., gives them a tractive power of 43,970 lbs. The details are in many respects similar to those of the Pacific type locomotives. This is especially true of the cylinders, with their piston and relief valves, the valve motion details, and many of the smaller fittings. The link bearings on the consolidation engines are bolted to the guide yoke, which also serves as a support for the reverse shaft bearings. The cast steel details for both types include such features as frames, wheel centers, driving boxes and spring saddles, cylinder heads, crossheads and foot plates. The tenders for both the passenger and freight locomotives are similar throughout. The tank capacity in both classes of engine [illegible] water, 8,500 gals., and oil, 3,300 gals.

The general features of the [illegible] classes are shown in the 4-6-2 engine which we illustrate and the principal dimensions of both are given below:

Atlantic Type Passenger Engine

Boiler—Material, steel; thickness of sheets, [illegible] 11-16 in.; fuel, oil; staying, radial.
Firebox—Material, steel; [illegible] width, 66 ins.; depth, front, [illegible] ins.; back, [illegible] ins.; thickness of sheets, sides, [illegible] back, [illegible] in.; crown, [illegible]; tube, [illegible]
Water Space—Front, 4[illegible] [illegible] ins.; back, 4 ins.
Tubes—Material, [illegible] No. [illegible] diameter, all [illegible]
Heating Surface—Firebox, [illegible] sq. ft.; tubes, 3,202 sq. ft.; total, 3,302 sq. ft.; grate area, 49.5 sq. ft.
Driving Journals—Main, 10 x 12 ins.; others, 9 x 12 ins.
Engine Truck Wheels—Diameter, front, 34¼ ins.; journals, 6 x 10 ins.; diameter, back, 50 ins.; journals, 8 x 14 ins.
Weight—Total engine and tender about 395,000 lbs.
Tender—Wheels, diameter, 34¼ ins.; journals, 5½ x 10 ins.

Consolidation Freight Engine

Cylinder, 24 x 32 ins.; valve, balanced piston.
Boiler—Type, straight; material, steel; diameter, 78¼ ins.; thickness of sheets, 11-16 in. and ¾ in.; working pressure, 160 lbs.; fuel, oil; staying, radial.
Firebox—Material, steel; length, 95½ ins.; width, 71¼ ins.; depth, front, 73[illegible] ins.; back, 62[illegible] ins.; thickness of sheets, sides, ⅜ in.; back, ⅜ in.; crown, [illegible] in.; tube, ½ in.
Water Space—Front, 4½ ins.; sides, 4 ins.; back, 4 ins.
Tubes—Material, iron; wire gauge, No. 11; number, 355; diameter, 2 ins.; length, 15 ft.
Heating Surface—Firebox, 157 sq. ft.; tubes, 2,773 sq. ft.; total, 2,930 sq. ft.; grate area, 47.4 sq. ft.
Driving Wheels—Diameter, outside, 57 ins.; journals, main, 10 x 12 ins.; others, 9 x 12 ins.
Engine Truck Wheels—Diameter, front, 29½ ins.; journals, 6½ x 1[illegible] ins.
Wheel Base—Driving, 15 ft. 6 ins.; total engine, 24 ft. 6 ins.; total engine and tender, 58 ft. 3 ins.
Weight—On driving wheels, 183,200 lbs.; on truck, front, 29,200 lbs.; total engine, 212,400 lbs.; total engine and tender about 375,000 lbs.
Tender—Wheels, diameter, 34¼ ins.; journals, 5½ x 10 ins.

Neither let mistakes nor wrong directions discourage thee. There is precious instruction to be got by finding we were wrong. A mistake of how to set a value once put on record with the result of failure to pass is certain to end in the acquiring of correct knowledge

FRAME FAILURES ON MODERN LOCOMOTIVES

By F. P. ROESCH

Master Mechanic, El Paso & Southwestern System

In 1904 the committee appointed by the Master Mechanics' Association to consider the question of large locomotive frames with reference to a study of the cause of breakage, how distortions are to be provided for, their preference as to material, etc., reported back to the association with quite a lengthy and complete report, but since that time, the question appears to have been relegated to realms of inoccuous dessuetude and quietly allowed to slumber.

With the advent of larger engines the percentage of broken frames has materially increased, although in design and strength of material per unit of power developed, the same factor of safety was maintained as in the older and smaller types of engines, it is therefore evident there is cause for this increase in failures, which apparently has so far been overlooked, or it would have been mentioned, together with the remedy.

The report while of great value for future guidance, so far as general design, material, etc., is concerned, yet we must admit is not all that could be desired in information for immediate relief, neither was anything brought out in the discussion that would tend to add materially to the value of the committee report so far as offering a panacea for present frame breakage.

A part of the report as submitted classified the possible causes of failures under three heads, vis: The inertia of the boiler following the sudden applications of brakes. The inertia of the boiler due to the sudden acceleration of the train. The dynamic effect of compression of water in the cylinders.

After discussing the two first mentioned causes thoroughly, however, and calculating the effect of the inertia of the boiler, both for sudden stops and sudden acceleration, the committee proceeds to completely demolish this hypothesis as a sole cause of frame breakage by proving that the inertia is far from sufficient in itself to cause failure. This leaves the last theory only as a possible cause.

Referring to this theory the committee reports as follows:

"The dynamic effect of the compression of water in the cylinders is the only force which, unaided, can cause the failure of frames by fatigue." While there is no question but that the dynamic effect of water in the cylinders, were the water entrapped, would be sufficient to cause a frame failure, yet we are here confronted by the inexplicable fact that we have many failures on engines having valves which will readily permit the escape of water by lifting, where the compression within the cylinder reaches an equality with the steam pressure acting on the top of the valve."

Further, as the combined area of the cylinder head studs is usually less than the cross-sectional area of the frame and consequently of less total strength, it is natural to assume that the cylinder head studs will give way first. However, we will pass this for the present.

In the report of the committee the effect of rounding curves is also touched upon but only in so far as the centrifugal action would produce or set up stresses which might result in frame failure. A careful calculation however, resulted in finding that the fiber stress on the frame of an engine entering a curve of 16 degs. at a speed of 30 miles per hour, was but 7,960 lbs. per square inch, and consequently far below the tensile strength of the material.

The report closes as follows: "While it is true that no one cause for frame breakage can be given, it is safe to say that all reasons assigned are, at least, contributory causes, and should be taken into account." The committee further recommends cast steel for material, and various submitted designs, and under the head of remedies to prevent breakage recommends as follows:

1st. Sensible design.

2nd. Material cast steel, made to a rational specification: Careful foundry manipulation, adequate and suitable annealing.

3rd. Provide form of bracing as will prevent "weaving." By weaving is meant a movement of one side independently of the other, or of separate parts or joints, with reference to each other locally; as, per contra, a movement of the frames as a whole in unison. The bracing should be so designed that the bending, if any, should be synchronous, as referred to the connected parts.

4th. The clip form of pedestal binder preferred to the thimble and bolt type.

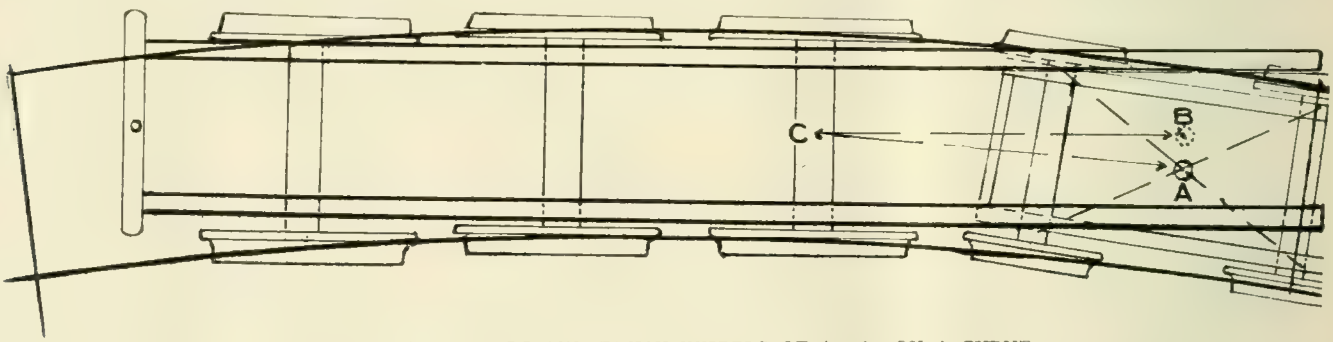
5th. Provision for quickly and adequately draining cylinders. This point is just as important with slide as with piston valves.

6th. Frames with single front rails should be made stronger, and means provided to stiffen same back of cylinders, or between cylinders and front drivers.

In the discussion the only additional point brought out having any bearing on the subject, and not covered by the committee report, was that made by Mr. H. H. Vaughn, in which he mentioned the distortion and twisting of the frame due to the side thrust of the leading driving wheel. The loose binder was also mentioned, the effect of this is self-evident however, and requires no discussion.

And yet there is nothing mysterious about frame failures; each can be traced to a direct cause, and once the cause is determined, the remedy is self-suggestive.

In a careful record kept, since the committee report, covering frame failures, in order to determine the exact cause of each failure, and so arrive at a solution of the problem regarding unaccountable failures, it was noticed,



POSITION OF DRIVERS AND TRUCK WHEELS OF A 4-6-0 ON A CURVE.

first, that frames failed on engines of the following types in the order named. 4-6-0, 4-6-2, 2-8-0, 4-4-2, 2-6-0, 4-4-0, 0-6-0. the 4-6-0 type easily leading in number of failures. The following were the percentages, being based on the number of failures per type of engine, as compared to the total number of engines of that type compared with the total number of engines of all types in service: 4-6-0, 47 per cent.; 4-6-2, 33 per cent.; 2-8-0, 11 per cent.; 4-4-2, 4.1 per cent.; 2-6-0, 3.3 per cent.; 4-4-0, 1.4 per cent.; 0-6-0, .2 per cent. (2/10 of one per cent.).

All of these engines were of late design, having been built since 1904. All had cast steel frames, and otherwise embodied all the points recommended by the committee in their report.

A further record was kept showing the location of the point of failure, together with the cause of same. Where the cause was not determined beyond question it was classified as "cause unknown." And here let it be said in passing, that the commonly assigned cause, "old flaw or old crack," should have no place in a record of frame failures, as there must have been an original cause to produce the first crack, which when the frame finally broke entirely, naturally showed up as an "old" crack. You can never get at the root of any trouble if you persist in fooling yourself.

The completed record of failures classified causes of same as follows: Loose binders, spring hanger worn, weakened by excessive number of bolt holes, keys lost out, blow holes, broke through old weld, and unknown.

Of the known causes, loose binders and spring hanger wear, were the most prolific. The failures due to loose binders, for which there is no excuse whatever, were in all cases located in the upper or main rail, and between the pedestal jaws. The failures due to frames being weakened through excessive hanger wear, another cause for which there is not the slightest excuse, of course occurred at the point of wear. Failures due to defective welds, applies to short or fore frames, which had previously failed, had been welded, and again failed. Failures due to blowholes in casting, but two were noticed, both being in the short frames.

It will be seen that of the above failures, with the possible exception of the undetected blow holes, all or nearly all could have been avoided. Loose binders, spring hanger wear, keys lost out, too many bolt holes etc., all betoken gross neglect or culpable ignorance.

We now come to failures classed as due to unknown causes. Let us apply to these the contributory causes as found by the Master Mechanics' Committee to see if to any or all of these the failures could have been attributed.

First let us call attention to the fact that of the unknown caused failures, nearly all were on passenger engines of the 4-6-0 and 4-6-2 types and none whatever on yard or 0-6-0 types.

Referring now to causes as stated.

First, inertia of boiler due to sudden application of brakes.

There is no question but that a yard or switching engine, receives more rough handling than any road engine, and especially if the comparison be made between yard and passenger engines, yet we find the percentage of total number of failures for the two types of engine to be 80 per cent. against the passenger (4-6-0 and 4-6-2) engines and but .2 per cent. against the switch 0-6-0 engines. Clearly a cause obtaining with one type of engine having practically the same cross sectional frame area in proportion to cylinder power, should likewise obtain with the other.

Following this line of reasoning we find that the first conclusion is untenable.

We next find for the second item, viz: Inertia of the boiler due to acceleration, that the same conditions apply, consequently we must eliminate this as a cause.

Third, water in cylinders. Here again we meet with the same objections. These objections apply very forcibly, not only to comparisons between passenger engines of the 4-6-0 and 4-6-2 types and switch engines, but between these same passenger engines and all other types of engines in service, and as like causes should produce like effects, and as all af the above locomotives are subject to exactly the same conditions, so far as handling, etc., is concerned, we find we must look elsewhere for a cause that will effect engines of the 4-6-0 and 4-6-2 types to a greater degree than those of other design.

Some years ago while engaged in taking indicator cards from engines of various design, the writer was very much impressed and also interested in the action of engine trucks of the "pony" type, two wheel, as used on 2-6-0 and 2-8-0 locomotives.

It was noticed that invariably in rounding a curve of 8 degs. or more, at a speed of 15 miles per hour or over, that the engine truck wheel on the inside of the curve was lifted clear of the rail, any distance from one half inch to as high as five inches, depending on the degree of the curve and the speed at which it was entered

This was at first attributed as due wholly to the centrifugal force, but upon taking an engine of 15 ft. rigid wheel base (2-6-0 type) around a 31 degs. curve very slowly it was found that a lift of 4½ inches of the inner wheel could be obtained, this proving that while in curves of lower degree, the centrifugal force materially effected the action of the truck, yet the primary cause must be due to the construction of the engine, preventing it from adjusting itself to the curve. Thinking perhaps that this lifting action was due to the construction of the truck we applied the standard three point hanger. We found however, that while it lessened the amount of lift, it did not as yet allow of sufficient lateral adjustment to overcome the lifting entirely.

We speak of locomotives as having a certain rigid wheel base, measured by the wheel base of the driving wheels. Admitting that the truck possesses a certain amount of flexibility, yet can we correctly assume the limit of rigidity of locomotives when passing through curves of a certain radius to be confined to the limit of the driving wheel base?

A glance at our illustration indicates that this assumption is incorrect, that under certain conditions, the entire locomotive becomes momentarily rigid, and that the limit of rigidity extends from the center of the engine truck to the center of the rear driving wheel. It is assumed in this case that the engine is running forward.

The cut represents an engine of the 4-6-0 type passing through a curve. The radius of the curve is somewhat reduced in proportion in order to make the explanation more clear. In the figure the drivers and engine truck wheels show as crowding the outer rail, a condition due to the impulse of the centrifugal force. The frames are shown as crowding against the wheels on the outer side of the curve with the slack or lateral play all on the inner side. The engine truck is also shown as crowding the outside of the curve, with the slack or lateral taken up on that side also; and yet—note this carefully—although the lateral is all taken up, and is in the figure somewhat exaggerated, the center between the frames as shown at B, clearly indicates that the engine truck still lacks considerable of being far enough over toward the outside of the curve to make the two points, A, center of engine truck, and B, center between frames, coincide.

While we must admit that in practice the male center casting, (point B) remains within and consequently coincident with the female casting (point A); yet a study of the figure will show that this can only obtain by a severe distortion of the frames, engine trucks, etc.

That this distortion takes place in engines of the 2-6-0 and 2-8-0 types, is proved by the observed lifting of the engine truck wheels from the inner curve rail, and due to this pull of the frames, as shown in the illustration.

This indicates that there must be a

certain distortion or bending of the frames under these conditions. The distortion would be between the pivotal point of the driving wheel base, and the engine truck center.

The pivotal point is usually the center of the forward pair of drivers, (shown at C) but is subject to change due to tire wear, lateral in leading pair of drivers, as compared to others, widening of gauge of track, etc. Throwing the pivotal point back increases the length of the angle of distortion A, B, C, and consequently lessens the evil in the same ratio by distributing the distortion through a greater length of frame.

Knowing from personal observation that this lifting action of the truck takes place in engines of the 2-6-0 and 2-8-0 types, and as the causes are identically the same, is it not reasonable to suppose that the same action occurs in the 4-6-0 and 4-6-2 types, even if it has been unobserved?

Further, is it not reasonable to assume, that this lifting of the pony truck wheel as observed in the 2-6-0 and 2-8-0 locomotives, affords a measure of relief for the enormous strains which must otherwise be absorbed in the frames?

And further, as the strain is necessarily greater in the 4-6-0 and 4-6-2 types of engine, owing to the increased distance between the leading drivers and the engine truck center, and as the four wheel truck is not so free to lift as the pony truck, is there not in consequence a greater percentage of this distortion absorbed in the frame of this type of engine? And does this not account for the increased number of frame failures, which obtain in the 4-6-0 and 4-6-2 class?

This distortion is in ratio to the distance between the engine truck center and the pivotal point of the driving wheel base, when the engine is on a certain curve; and as can be seen by a study of the diagram, advancing the engine truck i.e. throwing this center forward will increase the amount of distortion, while throwing the pivotal point back will decrease it. Assuming the engine in good condition and snug laterally the pivotal point as stated before would be the center of the leading pair of drivers, point C, and as this distance is usually less in the 2-6-0 and 2-8-0 engines than in in the 4-6-0 and 4-6-2 type, is it not reasonable to assume the consequent distortion is in like ratio?

Regardless of whether the truck pulls the frame over or the frame pulls the truck, the distortion is bound to occur, and this frame distortion can have but one effect, viz. frame failure.

The amount of distortion occurring on curves of various radii can readily be calculated, and a careful study of the frame design, bracing etc., will even reveal the point at which failure will occur; which is not at the point where the bending is most excessive; but where vibration is arrested. This may be just back of the cylinders, or just ahead of the forward jaw; again it may be back of the leading drivers, in case these have worn flanges or excessive latteral play, but is most apt to occur in the top rail just back of the cylinder and in the bottom rail, just ahead of the forward pedestal.

From the above facts it will be seen that the remedy for frame failures is obvious, viz: plot on the drawing board the shortest curve, which the engine is expected to enter, including turn-outs and sidings, and on this lay-out what is usually termed the rigid wheel base, viz. the driving wheel base; then from the center of the forward axle and midway between the frames extend the center line C-B, to a point opposite the engine truck center; now extend the line C-A, the point A being midway between the rails and the opposite point B; if now the allowed lateral play in the drivers, plus the lateral movement of the truck, which is the side play in the boxes plus one half the possible occillation of the truck center (in case it is a swing truck) plus the play of the wheel flanges between the rails (curves are usually opened), is not equal to the distatnce A-B, i.e. will not allow these two points to coincide, then more lateral play must be provided.

This can be done by allowing more lateral driving-box play in the front and rear wheels, or by setting the forward and back tires narrow, instead of to gauge; or both. Perhaps the only certain remedy would be to discard the four wheel engine truck entirely, unless used in connection with plate frames, as in European practice; or else to make the truck of the same design as used in trailing wheels, as a study in the diagram leaves it a question of doubt as to whether, with any engine having three or more pairs of drivers, the truck controls the engine or the engine controls the truck.

Perfection is being, not doing—it is not to effect an act, but to achieve a character. The mark is perfection—the prize is blessedness. Attainment is the highest reward.—These are the remarks of a philosopher who tells you in big words, that the work of the jaw is less useful than handiwork well done.

The executive committee of the Railway Supply Manufacturers' Association held a meeting in the United Engineering Societies' building in New York at the same time that the joint executive committee of the Master Mechanics' and the Master

Car Builders associations were in session in another room. When the question of deciding on the place of meeting for the June conventions came up, the members of the Supply Association were given the privilege of the floor, without vote in the M. M. and M. C. B. meeting. The members of the Railway Supply Manufacturers' Association present on this occasion were Messrs. Geo. Cooper, Alex. Turner, R. H. Weatherly, C. K. Allen, E. M. Groves, Frank A. H. Whipple, W. H. Miner and L. Phillips.

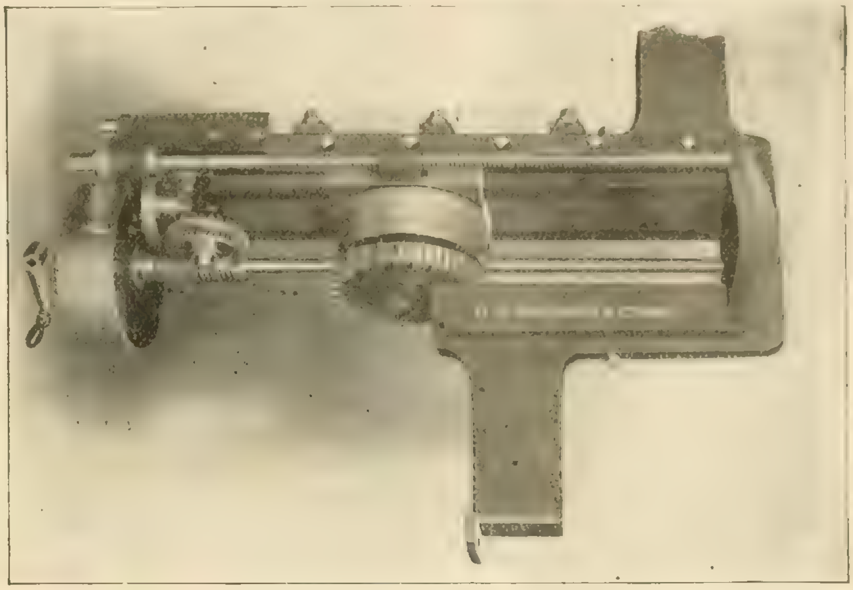
Truck Pedestal Facing Machine.

This Portable Machine as shown in our half-tone illustration, was designed for truing up the pedestal bearings on car truck frames after they have become worn out of true. It is a very strong, powerful tool having an inserted blade milling cutter, made of high speed steel, which has an adjustment of 1½ ins. in and out, allowing for different width jaws and also for the depth of the cut. Milling cutters of different diameters can be used. The driving is done by a worm and wheel geared 42 to 1, giving great power together with the smoothness which this manner of gearing produces. The feed is so arranged that a great number of different feeds can be used to suit the conditions, varying from very fine to very coarse.

The bed of the machine carrying the sliding head and milling cutter is made in the form of a chuck, with T-slots on both the top and bottom edges, on the back. In these fit the projections of the clamps that hold the tool rigidly to the pedestal. In the center of these clamps are adjusting screws that go through and clamp the whole device to the back of the leg without springing the bed or the work to be milled.

At the top and bottom edges are shown six set-screws for holding the machine edgeways and these in conjunction with the clamps hold the machine so firmly to the work that it practically becomes one piece. Parallel jaws are not the only ones which this tool will mill, for by placing wedge-shaped pieces in the chuck, the machine will mill the tapered side equally as well and in line, as the straight side. It is thus very easy to establish and maintain a standard. In very wide jaws a parallel piece can be used in the same manner, giving the tool a very wide range of work.

The regular cutter is 8¾ ins. in diameter and is capable of taking a deep cut, its large diameter leaves a very little circular corner, only about ¼ in. It is adjusted by a socket wrench which fits into and operates a cross-feed screw in the center of the cutter moving it in or out, and still retaining a long bearing for the shaft and driving device. The head has a 20 in. travel.



TRUCK PEDESTAL FACING MACHINE.

The machine is ordinarily belt driven, but the driving shaft end can be fitted to use an air drill or any portable power. Various sizes are built to meet requirements by H. B. Underwood & Co., 1023 Hamilton street, Philadelphia, Pa., and the machine will be found very useful in other fields than that of milling the jaws of car truck pedestals, for which it was originally designed.

Important Patent Decision.

This interference, relating to electric heaters having junction boxes, between an application of James F. McElroy and the patent to Edward E. Gold, No. 850,924, and dated April 23, 1907, has been decided by the Patent Office in favor of Edward E. Gold, president of the Gold Car Heating & Lighting Co., of New York, by reason of an abandonment by McElroy of his claim of priority. The official notice of the decision issued by

the Commissioner of Patents reads as follows:

"On November 11, 1908, James F. McElroy filed an abandonment of the invention involved in this interference. Priority of invention of the subject matter in issue therefore awarded to Edward E. Gold." The subject matter in issue includes four claims of said Gold patent covering a form of electric heater heretofore manufactured by the Consolidated Car Heating Company, namely:

1. An electric car heater having a resistance medium interposed between a pair of opposite heads through at least one of which a conducting wire passes and between which said medium is exposed to the air to heat it, and having a chamber outside of the head through which such wire passes, said chamber constituting a junction box for enclosing the connection of such wire with the line wire leading to the heater.

2. An electric car heater having a resistance medium interposed between a pair of opposite heads through at least one of which a conducting wire passes and between said medium is exposed to the air to heat it, in combination with a separate casing forming a chamber outside of the head through which such wire passes, said chamber constituting a junction box for enclosing the connection of such wire with the line wire leading to the heater.

3. An electric car heater having a chamber constituting a junction box for enclosing the ends of the line wires leading into the heater, said junction box having a socket for receiving the end of a conduit enclosing the line wire outside of the heater.

4. The combination with an electric car heater, of a line wire and a conduit enclosing the same, and a junction box receiving the end of said conduit and providing a space between said conduit and the heater and enclosing the junction between the line wire and the end of the heater wire.

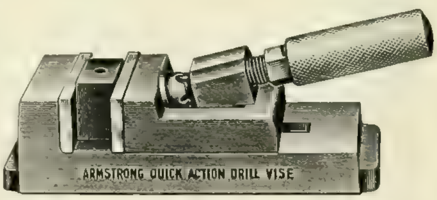
Air Brake Cylinder Ring

The H. W. Johns-Manville Company, of New York, have recently got out an improvement on the ordinary style of air brake cylinder packing ring which is meeting with much favor.

This ring is made of the best spring steel and is practically unbreakable. With even ordinary care in handling it will outlast the other parts of the brake equipment. It has many advantages, one of which is that it will prevent brake failures due to packing leather leakage, and it is said that it will increase the life of the leather at least threefold, by pressing a larger surface of leather against the walls of the cylinder and thus distributing the wear over a much larger area of leather. The makers claim that packing leathers now considered unfit for service, on account of very small bearing surface against the walls of the cylinder, may be put in service again by the use of this ring, and will give good service. This ring can be applied to any standard size of brake cylinder without changing any other parts of the equipment.

The company will be happy to send their neat little illustrated folder describing the J.-M. expanding ring to any one who writes to them for one.

We have heard of quick-fire guns and quick-action brakes, but here is a quick-action drill vise got out by the Armstrong Brothers Tool Company, of Chicago, "the tool holder people." The vise is very handy for tool makers and for general shop use. It is an original design, made by the Armstrong Co. The jaws are made of tool steel so that wear of the parts may be considered a long way off. One turn of the handle sets or releases the vise, so that its quick-action name is fully warranted, and it can be instantly adjusted to any size of work within the limits of its capacity. It has two lugs on each end



NEW QUICK-ACTION DRILL VISE.

and when a lot of similar pieces have to be drilled, the vise can be clamped on the drill table and the work dropped in between the jaws, a turn given to the handle, and the drilling proceeds. The sides are ground true and are at right angles to the bottom so that a workman knows he is setting his work "square" with this device without having to stop to make minute examinations each time he uses it. The sliding jaw draws down as it tightens and thus grips the work solidly. The handle provides a safe and convenient means of resisting any tendency of the work to twist under strain. It is made in three sizes. Write to the company for circular.

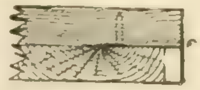
The Pratt & Whitney Co, of Hartford, Conn., have recently sent us a very handsomely finished catalogue of their multiple drills. In it are described and illustrated a line of drilling machines adapted for various classes of work. These tools have been very carefully designed. They possess sufficient weight to insure strength and durability without clumsiness, and are convenient to operate and are accurately made. Most of these machines, we are informed, are kept in stock by

the company or are in process of construction, so that any type or size may be promptly furnished complete. Special tools and appliances for use in connection with these machines are designed and built to order. The Pratt & Whitney Co. manufacture a great variety of types and sizes of precision machine tools, machinists' small tools, gauges, etc.; catalogues of these will be furnished upon request by the company. The multiple drill catalogue is the same size as our paper and has 28 pages, upon which are a series of excellent half-tone cuts showing the machines, and a full descriptive letter press accompanies each. This catalogue will be mailed to anyone who applies to the company for a copy.

Refrigerator Car Door.

A new refrigerator car door, handled by the Trenton Malleable Iron Company, of Newark, N. J., called the "Trenton Refrigerator Car Door" (Johnson patent), is shown in our line illustration. It is composed of one piece and is a flush door, but comes out and slides away from the opening, similar to the flush doors in use on ordinary freight cars. As will be seen from the engraving, there is no chance for this door becoming unfastened and swinging out so as to foul passing trains, which when it happens with the ordinary door does considerable damage, sometimes even causing wrecks. It will also be observed that the door can be opened from any platform, thus getting rid of the necessity of opening the door before coming up to the platform and backing the car away from the platform before being able to close the door.

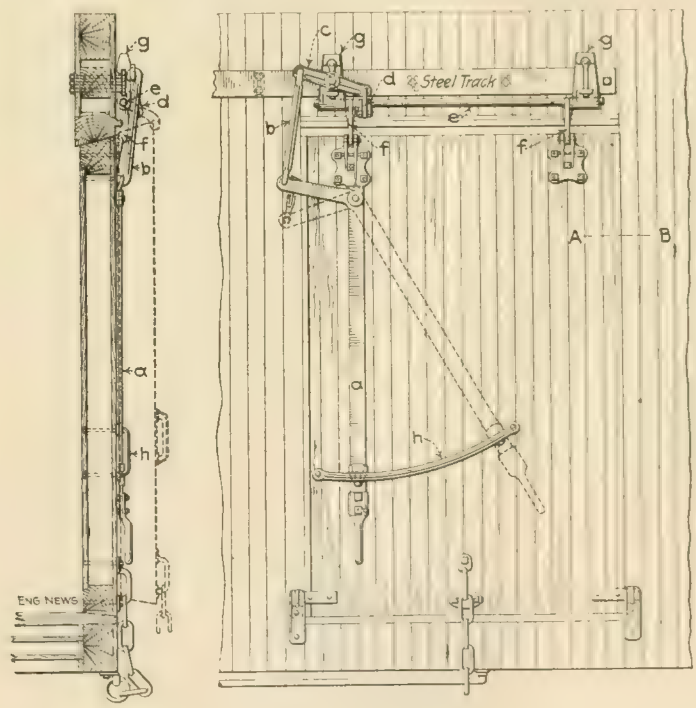
The illustration also shows the mechanism. This consists of a system of levers, connected by links through a rocker shaft, which is provided with arms. These arms support the door when open and keep it pressed close to its seat when closed. The rocker shaft is supported by two hangers, which run on a track when the door is being opened or closed. When the door is closed the bottom is prevented from swinging outward by two brackets, one on either side of the door, which engage



SECTION OF DOOR IRON.

with lugs fastened to the door. These brackets, being beveled, enables the door to be forced in tightly to the seat at the bottom. A chain fastened to the bottom of the door connecting to and sliding on a rod under the car, prevents the door from swinging out when opened. It will also be seen that the hangers or trolleys supporting the door on the track have roller bearings on the side to take up the friction due to the eccentric hanging of the door when open.

To operate the door the lever is disengaged from the rack and forced to the position shown by the dotted lines. This operation rotates, by means of link motion, the rocker shaft, which throws the door out and upwards, disengaging the lugs from the brackets at the bottom and the whole door is swung out ready to be moved away. To close the door it is only necessary to push the bottom of the door in and force the lever back to its first position which drops the door down and the lugs fit into the brackets at the



TRENTON REFRIGERATOR CAR DOOR.

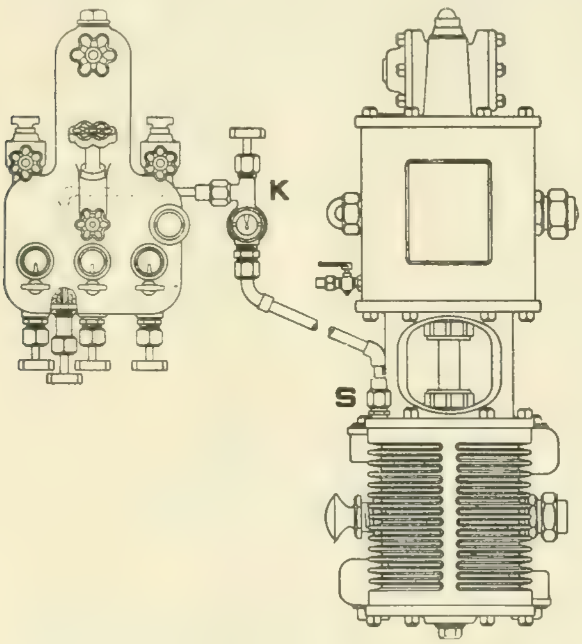
bottom, and the levers force the door to close at the top. The door is securely held in place, thus sealing the car positively.

The advantages claimed for the door are that it is one piece, necessitating less insulation; that it can be opened at any platform or any place, is easy and speedily opened and closed, economical in first cost, with minimum maintenance expense, that it makes an absolutely tight joint and that it is not possible to become unfastened and so interefere with passing trains.

The Trenton door irons, handled by this firm, are of great use, both in the refrigerator car and flush door, for the protection of the door, and to keep it from getting larger due to any swelling of the sheathing. This is done by fastening these door-irons on the battens of the door, and the sheathing is placed in these irons allows room for the swelling, or the contraction of the sheathing, due to moisture. This prevents the sheathing of the door binding against the door jamb, and at the same time it allows the door to fit very closely. These door irons have proved very efficient both on the refrigerator and flush doors.

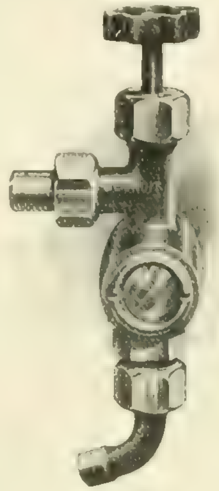
Air Cylinder Lubrication.

The lubrication of the air cylinders of locomotive air pumps has been made the subject of a folder just issued by the Detroit Lubricator Company of Detroit, Mich. The ordinary method of oiling the pump air cylinder is by the use of a small oil cup placed on the pump, and in case the pump becomes hot the small quantity of oil held by the cup is quickly used up, with possibly the carbonization of the oil and the clogging up of the passage, to say nothing of the inconvenience to the engineer and fireman if they attempt to keep the pump oiled frequently by hand.



LUBRICATOR AND PUMP WITH LUBRICATOR ATTACHMENT.

The device designed by the Detroit Lubricator Company not only obviates all this trouble, but is more economical of oil when an intermittent supply is introduced by a separate oil cup. This device gives the engineer complete and convenient control of the lubrication of the air cylinder of the air pump, as well as insuring the use of proper oil. It consists of three parts, the emergency valve, the sight feed fitting and the check-valve connection. It is also made in two styles, single-feed and double-feed patterns. The single-feed style is intended for use on locomotives equipped with either a 9½-ins. or an 11-ins. Westinghouse air pump. The double-feed style is intended for use on locomotives equipped with two Westinghouse pumps, with a New York duplex pump, or with a Westinghouse compound air pump.


SINGLE SIGHT FEED VALVE.

The oil is supplied from the oil chamber of any of the Detroit locomotive lubricators, bullseye type, by removing the plug and screwing in place the emergency valve. This emergency valve is not intended to be used in any case as an oil regulating valve, but simply, as its name indicates, as an emergency shut-off valve in the event of accident to or leakage in the supply pipe between this valve and the sight-feed fitting. The sight-feed fitting, which is equipped with the regular bullseye glasses, may be either to the right or left of the regular locomotive lubricator, or at any convenient point

on the boiler head within reach of the engineer.

In order to prevent compresed air from entering the oil delivery pipe between the sight-feed fitting and the cylinder of the air pump a check valve is provided, containing a ball which seats upward. This check-valve connection is screwed into the place usually occupied by the oil cup.

The Detroit Sight Feed Lubricator Company do not advise a constant feed to the air cylinder; in fact, they recommend that no more than ten drops of oil be fed at any one time. Experience, they say, has shown that the best results are obtained when a limited quantity of oil is fed at intervals, according to the judgment of the engineer.

We illustrate the single-feed attachment, and our line engraving represents the single feed attached to an ordinary Westinghouse air pump. The Detroit company have issued a very neat explanatory folder in the subject, and will be happy to send it, or give any further information on the subject to anyone who writes them direct.

Rattling Windows Made Quiet

Everybody knows the value of weather strips on dwelling houses. The fact that they prevent a lot of cold air from blowing in at the edges of closed windows has caused even the somewhat self-seeking landlords of apartment houses in our larger cities to apply them for the benefit of their tenants. Even the hardened janitor who neither "fears God nor regards man," is pleased to see the weather strips go on the windows for the simple and beautiful reason that in consequence he does not expect to have as much coal to shovel into the furnace as he otherwise would.

Cold air from the window cracks drinks up heat, and this is true in railroad as well as in dwelling houses. The Frost Railway Supply Co., of Detroit, have a weather strip for passenger coaches which is called the Detroit metal weather strip. Not only does this window protection keep out cold winds, but it excludes dirt, smoke, soot, rain, snow and sleet. In fact, as the Frost Company say in a neat little booklet on the subject, "A passenger, covered with dust, sitting by a rattling window that admits draughts, could not be pleased even if he were riding on a pass—to say nothing of cheap mileage."

The weather strip is simplicity itself, and to quote again from the booklet, "The strip has the elasticity of rubber, the running smoothness of oiled bearings and the wearing qualities of steel. These qualities are due to the easy adjustment of the strip and the use of a special grade of spring brass. This ensures a permanent grip at all times, and when the window is pulled up or down it allows a free movement of the frame. It also prevents the window falling upon the arms or hands of passengers. The strip does not bind or stick, while it takes up the inequalities of sashes due to warping or shrinking. It prevents the eternal rattling of windows in the moving train, which is one of the greatest annoyances of travel." Write to the Frost Company for a copy of the booklet if you are interested in knowing how the Frost appliances installed inside will keep the frost outside.

Where Are the Diamond Stacks?

A correspondent writes us for information as to whether there are any engines now in service using the old-time diamond smokestack. He wishes to secure a good snap-shot photograph of such an engine if anywhere to be had in the Eastern States. If any of our readers can give us this information we will be happy to publish it, and if any of our readers care to send us a good snap-shot photograph of a diamond smokestack engine anywhere in this country, Canada or Mexico, we will reproduce the picture, giving credit to the snap-shotter.

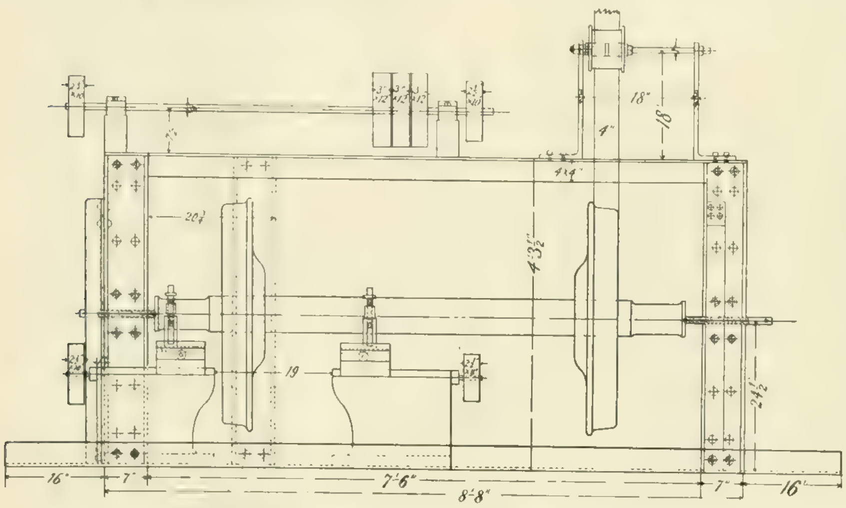
For many years the McConway & Torley Company, of Pittsburgh, Pa., have been furnishing car couplers to steam railways. They were among the original promoters and manufacturers of the M. C. B. type of coupler, and have manufactured and sold nearly 2,000,000 couplers of that type, so that the Janney coupler is well and favorably known wherever steam cars run. They are now prepared to serve electric railways and have worked out an adaptation of the Janney passenger coupler, similar to that in extensive use on the steam lines. This new design is intended to meet the requirements of electric interurban service. So far as the coupler itself is concerned, its effectiveness has been demonstrated by years of service and the makers state that it meets all the requirements of the Safety Appliance Law. They have also designed an application to meet the special and peculiar conditions of electric interurban service, so that such cars may now be equipped with couplers that will enable the interchange of cars between steam and electric lines, if desired, and complying with all the increasing demands of service and with state and national laws in relation to safety appliances. Our illustration shows the style of coupler to which we refer. A very neat little folder issued by this company, dealing with the subject, will be forwarded to any address on application to the company.

Journals Turned or Trued.

Out in Horton, Kan., in the shops of the Chicago, Rock Island & Pacific, they have got up a very efficient axle lathe. It was designed by Mr. J. J. Acker, the general foreman of the shops. It has been in successful operation for several months and all speak highly of it.

The lathe is capable of taking in an axle with a pair of wheels on it and when in place one of the wheels is used to drive the axle. The driving belt is slipped over the journal after the wheels have been rolled in on the lathe bed, if we may call it so, and as soon as the wheels are lifted up and the centres run in, the belt is slipped on the tread of the wheel. The tension necessary to drive is put on the belt by means of an idle wheel on the top of the lathe frame. This wheel is flanged on both sides so that the belt, when driving on a wheel with a coned tread, does not come off.

The object of the whole arrangement is to turn or true up the journals without taking the wheels off the axle, and we are informed that the economy effected by this simple shop-made device has paid for itself in six months' time. There are two tool-rests which are substantially made and can be moved wherever required on the lathe bed. The lathe is arranged so that the wheels have not to be lifted very high, only a few inches off the ground, and this is readily accomplished by a small jack with suitable head applied to the centre of the axle. The lathe is not very expensive to make and is an exceedingly useful tool from several points of view. Our line-cut illustration gives a good general view of the machine, and a few of the dimensions are given for the benefit of our readers.



LATHE FOR TURNING OR TRUING UP JOURNALS.

We have received a neat little descriptive catalogue of the Westinghouse Nernst multiple glower lamps. It is called Bulletin B. These lamps are suitable for all kinds of illumination, such as offices, railroad stations and platforms. Both indoor and outdoor service may be had from these lamps. For lighting large interiors the use of a single lamp in a bay is good practice from an engineering point of view, not only on account of the architectural effect produced but on account of the economy of the single unit so used. The lamps are made in large variety of sizes so as to suit a wide range of conditions. The catalogue contains illustrations of the lamps with details of their construction and a full list of sizes for window and outdoor use, with the price of each. Write to the Nernst Lamp Co., Pittsburgh, Pa., if you are interested.

Indestructible Smoke Jack.

The H. W. Johns-Manville Co., of New York, have just placed on the market a new fireproof smoke jack known as the "Phoenix," for which they claim many advantages. It differs from the ordinary "built up" jack because it is not made of many pieces held together with flanges and bolts, but consists of only three separate and distinct parts, each of which is in one piece without a seam or joint of any kind.

The Phoenix Jack is made of fireproof plastic material which is moulded into the desired shape and sets hard in a few hours. When thoroughly dry, it is very hard and is strong and durable. The materials used in making it are fire and acid proof and the jack is not affected in any way by heat, moisture, acids, or the gases of combustion. The entire jack is reinforced with extra heavy galvanized iron, wirecloth which is imbedded in the material and gives it strength and rigidity. The jack consists of the hood, the circular stack and the cowl, all of which are finally fastened together with Phoenix Compound in plastic state, producing a one-piece jack.

The jack is supported entirely by

hanging rods attached to eye openings in the hood. These openings are made of the same material as the jack and are reinforced with heavy wire cable, the ends of which are unraveled and interwoven with the wirecloth. This makes the eyes strong enough to sustain the weight of the jack, and by spreading the rods attached thereto the weight becomes distributed over a large area of the roof. After it is in place these rods are covered with Phoenix Compound to prevent deterioration. The interior is perfectly smooth, and it offers therefore an unobstructed and smooth surface with no tendency to prevent the escape of the smoke.

The J-M Phoenix Jack is made in standard sizes or any special size that may be required. It is constructed from materials and moulds furnished by the company, which are shipped to the roundhouse, where the jack is made and set up. The average thickness of the jack is ⅝ in., and the weight from 4 to 4¼ lbs. to the square foot. The company have recently issued a descriptive folder which will be sent on application to anyone interested.

One of the locomotives on the Great Central Railway of England has been fitted with a new type of cylinder lubricator. The lubricant is graphite, and the apparatus consists of a brass box into which is fitted a small pump, which forces graphite mixed with oil into the main steam pipes where it mixes with the steam. It is claimed that after a few days' service a coating is formed on the working faces which reduces friction to a minimum. The pump is worked by a crank similar to the cranks used on engines fitted with the Walschaerts gear. The Joseph Dixon Crucible Co.'s graphite has been used for the same purpose in this country.

The question, "What are your lime kiln costs?" is very fully answered in a neat and artistic pamphlet just issued by the Harbison-Walker Refractories Company, of Pittsburgh, Pa. The pamphlet is principally addressed to manufacturers who use firebrick, but it is also of interest to railway men as this company makes firebrick for use in locomotive fireboxes, forge furnaces, cupolas and indeed, for any purpose where a good quality of fire-resisting material is required. One of the secrets of the success of this company is the selection of the raw material used. All the clays are carefully tested by every practical and scientific method, before the brick is made. Another open secret about this company is that they make what suits conditions. They have, therefore, a wide variety of shapes and sizes for their customers to choose from, and it amounts to this that if you want any kind of firebrick for any sort of purpose it is a good plan to write to the Harbison-Walker Co. The pamphlet before us is well printed, is written in clear, good style and is illustrated by a number of what may be called apt pictures artistically drawn.

Unique Catalogue

We have just received what may fairly be called a unique catalogue. It is issued by the well-known firm of Manning, Maxwell & Moore, of New York. This catalogue is not only the first of its kind, but gives a thorough presentation of modern machine tools designed for service with high-speed steel and with the latest devices in motor drives. For this reason alone, the catalogue is unique and is of the greatest value.

The tools illustrated and described are grouped most carefully, to enable anyone examining the book to conveniently investigate the different lines of machine tools, etc., represented therein. For example, the first 125 pages are devoted to a general line of tools for service in railroad machine shops. A large section of the catalogue is devoted exclusively to electric traveling cranes, dock cranes, wrecking cranes and other similar devices. These two examples give a clear idea of the general grouping which has been followed out in the compilation of the book.

As to the quality of the book it is unnecessary to speak. The American Bank Note Company designed and produced it. The quality of the paper, the workmanship shown in the text, and the excellence of the cuts all speak most emphatically for the care given to the production of this catalogue.

For the convenience of those using the book, a careful codification of all types of machine tools and appliances illustrated has been made, each illustration, of which there are 2,750, is marked by a number to be used in ordering. The book contains 1,175 pages of valuable information regarding the latest designs of machine tools now in the market. It will prove a valuable addition to the library of any one to whom it has been sent.

When Saloons Were Respectable.

It is curious to note how fashions and tastes change. Drinking saloons are now under a ban in all parts of the country, especially with railroad officials, yet in the pioneer railroad days taverns were considered highly suitable as station houses. A historian of long ago conditions, says: "The tavern keepers and landlords are the only lords in Pennsylvania. They furnish us with militia generals and colonels and members of Congress, and do the honors of every town, keeping up their reputation for hospitality and good cheer."

Fewer People Killed and Hurt.

A statement recently issued by the Interstate Commerce Commission gives the number of casualties on railroads during the year ended June 30, 1908. The figures show the total number to have been 72,753, or 3,764 killed and 68,989 injured; this is a decrease in the total for last year. The decrease amounts to 4,533, there being fewer people by 1,236 killed and 3,297 injured.

During the three months ended June 30, the total number of casualties was 13,689, or 591 killed and 13,089 injured, being a decrease of 1,752 in the total number reported in the preceding three months. Figures include only accidents to passengers and to employees while actually on duty on or about trains.

The total number of collisions and derailments in the quarter was 2,130, or 820 collisions and 1,310 derailments, of which 130 collisions and 198 derailments were with passenger trains. The total damage to cars, engines and roadway by these accidents amounted to $1,617,398. This shows a decrease of 520 in the total number of collisions and derailments as compared with the number reported in the preceding three months. The commission attributes the reduction in casualties to the stricter enforcement of the safety appliance act strengthened by decisions of the federal courts.

Within the last few months considerable progress has been made upon the Pennsylvania Terminal in New York. This station is to receive the trains reaching Manhattan Island through tunnels under the Hudson and the East River. In the center of the terminal excavation has arisen a temporary wooden scaffolding which is said to have cost the contractors about $40,000. This woodwork is for use in constructing the skylight roof of the general waiting room. The waiting room will be 320 ft. long by 110 ft wide, and will have a pitch from floor to roof of 150 ft.

The granite colums are already in position on the Seventh avenue .front They have the appearance of bearing much of the weight of the building, but in fact, they themselves are supported underneath the street level by steel columns. These columns are to be protected, like the others in the building, by a covering of tile.

The tunnels under the two rivers were bored through some time ago, and are practically complete. Altogether there will be a million square feet of solid masonry floors in the building. More than 600,000 square feet of hollow terra cotta blocks will be used for partitions and for covering steel columns. It is intended to be an absolutely fireproof structure.

CONTENTS.